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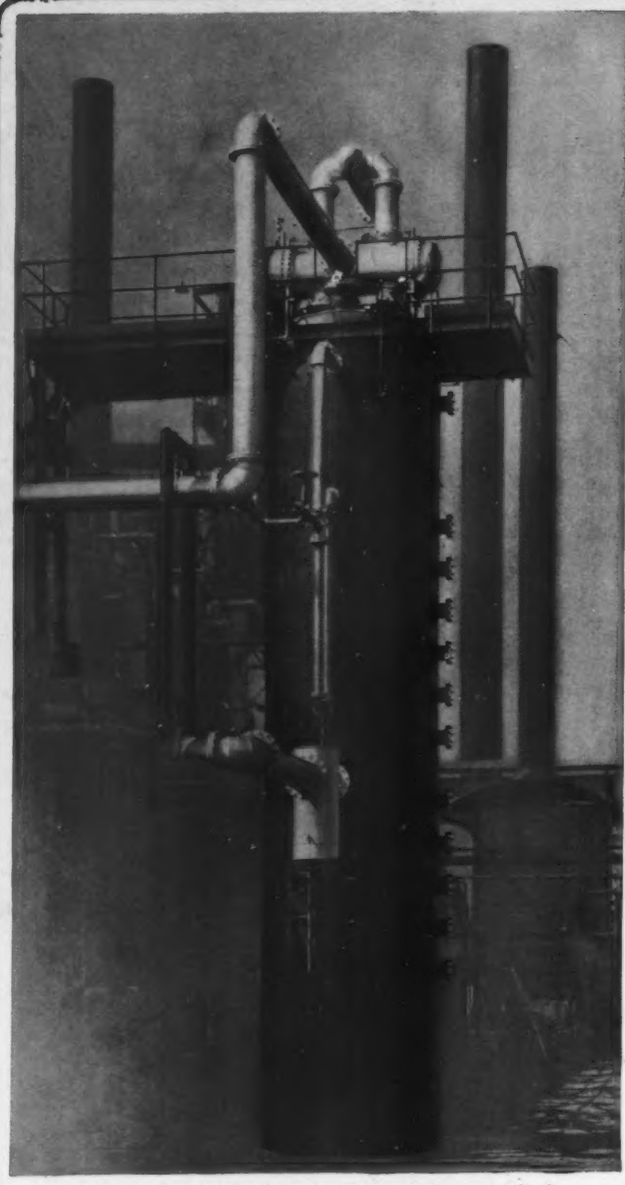

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*Entered as second class matter June 16th, 1923, at the Postoffice at Houston, Texas, under the Act of March 3, 1879*

*A Gulf Publishing Company Publication*

# THE REFINER

## and Natural Gasoline Manufacturer

*Member Audit Bureau of Circulations*

Vol. 8, No. 11

NOVEMBER, 1929

GRADY TRIPLETT, *Editor*

GEORGE REID, *Associate Editor*

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EDITED MONTHLY AT TULSA, OKLAHOMA
*Copyright, 1929*
*Published Monthly*
*by*
GULF PUBLISHING COMPANY
OFFICE OF PUBLICATION
3301 Buffalo Drive, Houston, Texas

R. L. DUDLEY, *President*
A. L. BURNS, *Gen'l Manager*
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PITTSBURGH: 510 Park Bldg., W. W. Pigue, Manager.

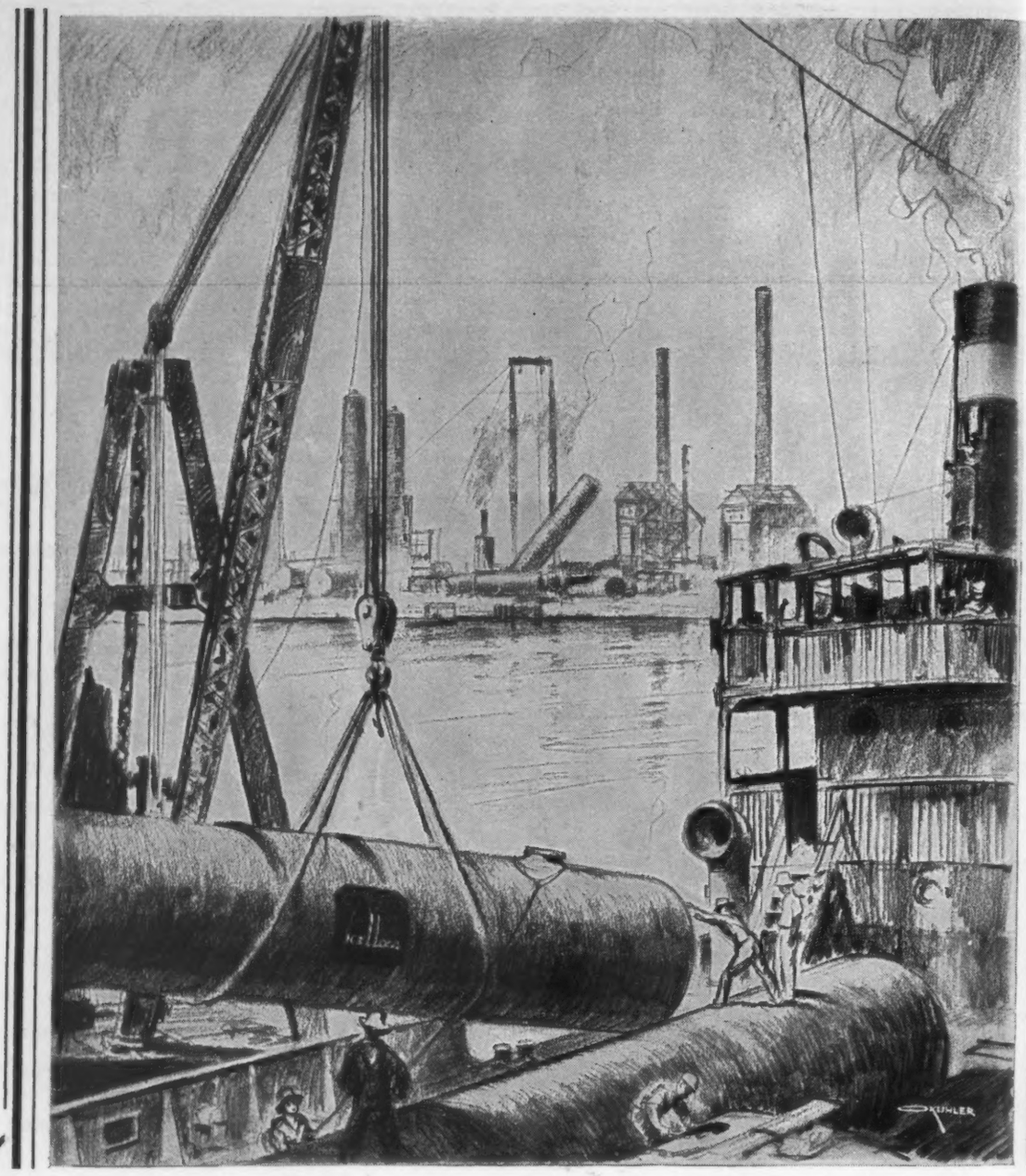
CHICAGO: Room 624 S. Michigan Ave., O. R. Waller, Manager.

LOS ANGELES: 416-417 Haas Bldg., W. E. Green, Manager.

TULSA: 913-916 Hunt Bldg., J. F. Carter, Jr., Manager.

FORT WORTH: 203 W. T. Waggoner Bldg., H. H. King, Manager.

Single copies 20 cents. Domestic and Foreign subscription price, $1.00 a year. Advertising rates on application.

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# There Is More Than Gasoline in a Barrel of Crude Oil

FOR all of the hundreds of valuable commodities that may be taken from a barrel of crude oil, it seems inconsistent that a barrel of crude oil should be interpreted in the one product gasoline. In the plant having only skimming and cracking facilities, gasoline is the measuring stick of plant operation, plant accounting, and all selling.

When the subject of cost accounting was before the Manufacturers' Committee of the Western Petroleum Association, October 29, many were free to admit that gasoline formed the basis for their calculation.

For gasoline they wanted a price. For kerosene and distillate, they accepted whatever the market will allow.

By this interpretation, gasoline is a major single product, which must be sold at a definite price to assure profit. But kerosene and distillate come as by-products, from which is expected whatever the buyer will give.

There can be no denying that the object of operating a skimming and a cracking plant is to make gasoline. It must be admitted also that there is difficulty in determining costs on other products from either or both of these plant processes.

But it must be recognized that kerosene is a desirable and essential product. It has a market as definitely established as has gasoline. In plant operation it may not be desired, but the petroleum industry is compelled to sell kerosene, whether it is preferable to do so or not.

It would seem, therefore, that the refining industry should adjust its estimate of the products, other than gasoline, which come out of a barrel of crude oil. If there are difficulties in arriving at the cost of producing these products, they are comparable to gasoline, for the refining industry is still struggling with the problem of correct accounting methods on gasoline.

One of the difficulties concerning gasoline profits is that it is impossible to know what will be realized from other products. It would seem that the whole matter of knowing costs would come to solution by considering a barrel of crude oil for all that it contains, instead of from the major product it contains.

Certainly a market can be better established when the refining industry has some knowledge of what it should receive for its other products. As long as finished products are sold at what the buyer will pay, the maker of these products will have no basis to determine in advance the money he gets from plant operation.

Although difficulties of accounting are intricate, it must be admitted that there is a cost in the making of kerosene or coke. If they represent a cost, they demand a price that will allow profit.

A few industries have come to find their "by-products" of equal value with major products. Whether they came to this realization through study or through accident, the lesson is one the refining industry can take for its own consideration.

The sawdust of a lumber mill is no longer burned. If there is not a price to be fixed on sawdust, the lumber cutter is missing a chance for profit, for sawdust is now converted into lumber by pressing.

To the refiner "by-products" are of greater importance than sawdust is to the saw mill, for the refiner must finish his wares. The irony of it is that he finishes the products and then sells at whatever price may be, without effort to determine what the price should be.

Grady Gilbert

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# Refiners Face Excess Gasoline Supply

By H. J. STRUTH
*Staff Economist*

THE petroleum industry is rapidly getting its house in order but the refining branch of the industry is still somewhat out of line. With definite assurance that producers of crude can and will balance production with demand, it is imperative for the refining industry to complete the movement toward stabilization by exerting strenuous collective effort to make still run schedules conform to the normal demand for gasoline. If the refining industry manages to exercise reasonable vigilance over still run schedules during the next few months, conforming them to normal gasoline requirements, 1930 will prove to be the most prosperous year the industry has ever enjoyed. After all, the logical economic sequence of the country's oil supply should begin with the demand for gasoline, followed in turn by an equivalent demand for crude by the refiner and the necessary withdrawals of crude oil from proven natural reservoirs controlled by the producer. Apparently, this sound organization of the industry's economic forces may soon become a realization. In the meanwhile, it is up to the refiner to carefully determine his normal requirements and make every effort to adhere strictly to predetermined schedules.

## RESULTS OF UNCONTROLLED STILL RUNS

Conditions during recent months in both the producing and refining branches of the industry have been decidedly unsatisfactory. Producing crude at an unusually excessive rate has weakened the entire market structure to a degree where both the producer and refiner have suffered. However, the premature weakening of refined oil prices, during the season of peak demand can be primarily attributed to the neglect of refiners to maintain still run schedules in conformity with normal gasoline requirements. Throughout the first six months of this year, refinery crude runs to still were considerably in excess of normal, while during July, August and September, some effort appears to have been made to reduce runs to stills. The reason for this can be ascribed to the fact that gasoline stocks had reached the point, in many instances, where it became necessary to curtail output. This condition shows that practically no effort has been made by refiners this year to prevent an over-production of gasoline through the medium of reduced still runs.

A check-up of refinery statistics for the first nine months of this year, as revealed by the Bureau of Mines report for September, indicates that refiners are faced with an excess gasoline supply of nearly 50 million barrels. Last February, the writer estimated the 1929 gasoline demand at 18,396,438,000 gallons, or approximately 438 million barrels. This estimate was further amplified in the April issue of THE REFINER, wherein the probable gasoline demand was detailed according to various uses, as well as on a monthly basis. It is of particular interest to note that the cumulative estimate for the first nine months of this year checked almost exactly with the actual demand reported by the Bureau of Mines. The estimate for the first nine months aggregated 13,845,000,000 gallons, or 329 million barrels, while the actual demand for that period proved to be 326 million barrels. The high degree of accuracy shown by these estimates makes it quite evident that the total demand for this year will practically equal the predetermined figure of 438 million barrels. Since it has been proven, year after year, that it is possible to predetermine the gasoline demand with a high degree of accuracy, it remains only for the refining industry to accord full recognition to these facts and endeavor to maintain a fair degree of equilibrium through prescribed still run schedules. Until the industry does give proper recognition to the economic significance of available statistics, there will continue to be over-production of gasoline, and all other products, with consequent periods of lean profits.

Following is the status of the 1929 gasoline situation, as indicated by the facts at hand:

| | Millions of Barrels |
|---|---|
| Domestic gasoline demand | 370 |
| Exports | 68 |
| Total gasoline demand | 438 |
| Gasoline Imports | 9 |
| Net Domestic gasoline | 429 |
| Natural gasoline content | 50 |
| Net gasoline from crude | 379 |
| Gasoline produced first nine months | 320 |
| Amount required last three months | 59 |
| Probable production last three months | 105 |
| Indicated excess production | 46 |

The time is at hand for the refining industry to apply corrective measures that will solve the over-production problem. Apparently, producers of crude have reached a degree of stabilization that is a long step in the direction of balanced supply and demand. Judging from latest advices from California, production there will show a drastic decline throughout the balance of this year. As the producing situation appears now, it is apparent that crude production will probably aggregate 94 million barrels for October, 80 million barrels during November, and 77 million barrels during December. This indicates that the total domestic crude production of the United States will aggregate approximately 1,010,000,000 barrels during the present year. Together with imports, the indicated crude supply amounts to 1,098,000,000 barrels. On the basis of actual and indicated crude requirements, it is apparent that the industry will conclude this year with a net surplus of approximately 100,000,000 barrels of crude petroleum.

# The Carburol Cracking Process

By DR. KARL BENDER
*In Petroleum Zeitschift*

WHEN it is possible to carry out the cracking process so that no formation of coke results, which means that no free carbon can be formed, and the higher fractions are removed from the apparatus still in the liquid phase, then the essential requirement for a continuous process would be fulfilled. Instead of the practically unsaleable coke, a residual oil would be obtained, which can be used for practical purposes according to its viscosity, that is, either as a fuel oil or also for the manufacture of a high grade paving asphalt. The latter possible use of this oily residue is highly important from the standpoint of the economy of the cracking process.

Inasmuch as it is quite characteristic of the oil industry that the value of the products that are manufactured in the refineries varies considerably, the ideal cracking process must be such that it can adjust itself to these variations. Thus for example it must afford the possibility of adjusting both the grade and the quality of the cracked gasoline to the grade and quality of the residual oil in the stills, and furthermore, the production of gas must also be at least sufficient to supply the demand. Investigations which have recently been carried out have proven that cracked gas is not an unavoidable difficulty. It has been clearly indicated that this gas constitutes an important raw material for making various chemical products, and it can also be directly used for such purposes as the carburation of low thermal value water gas, for driving gas motors and as a substitute for acetylene in welding.

The Carburol cracking process, which is described below, is claimed to be a process which can be easily and accurately adjusted to meet the various requirements, as mentioned above. It is a process which yields in continuous operation, and without the deposition of coke, the products gasoline (not a distillate under pressure), gas and a residual or heavy oil. The arrangement of the apparatus used in this process can be seen from the accompanying illustration.

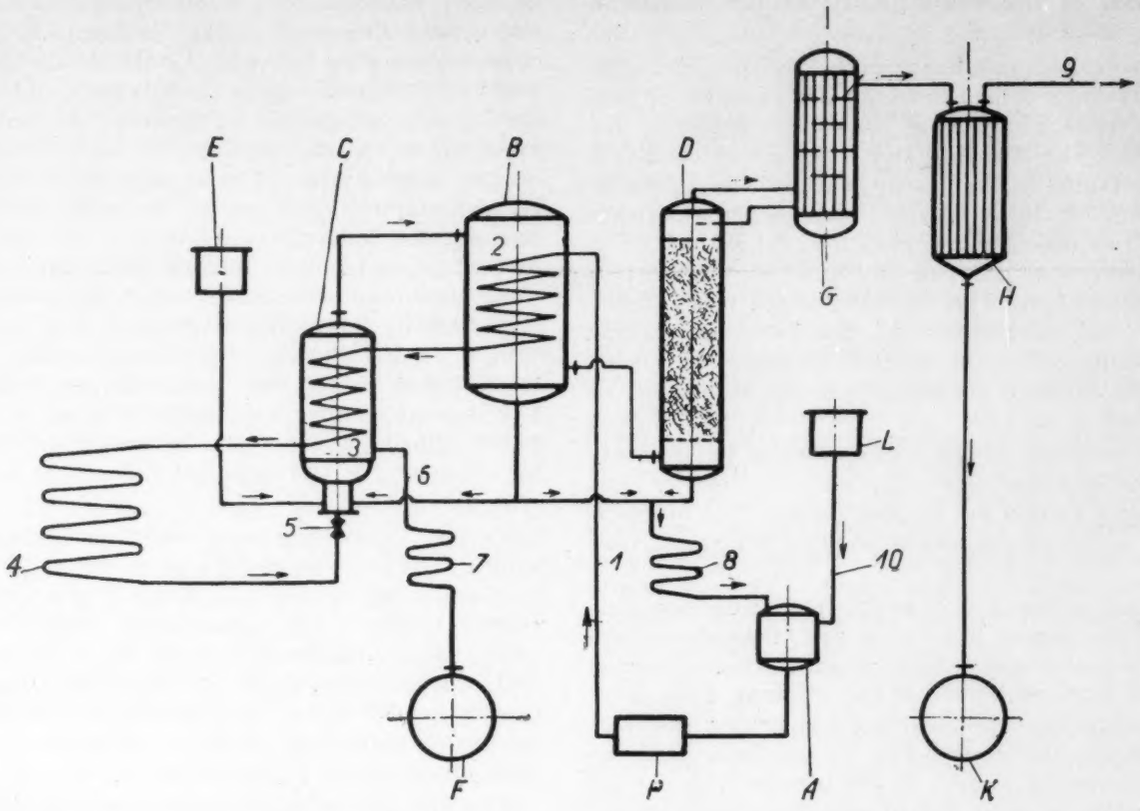
The pressure pump P draws the oil, that is to be cracked, out of the storage tank A, and forces it through the pipe 1 and the preheating coils 2 and 3 into the cracking coil 4 of a heated still or furnace. The oil passes through the cracking coils at a definite rate of speed, while it is being raised up to the cracking temperature. It is maintained at that temperature for a given definite period of time. Gasoline is formed under these conditions. The oil, which is under high pressure, is allowed to expand in the expansion valve 5, so that this pressure is relieved, and at the same time distillates from the tower still B, or fresh oil from the tank E, are mixed with it. This mixing of the cracked oil and fresh oil, or distillates, has for its essential purpose rapid reduction of the temperature of the cracked oil, with the result that the cracking of the oil is momentarily interrupted. Then the heavy boiling constituents of the oil, which contain large amounts of carbon, are separated out in the coil 3 of the tower C by further cooling. The coil 3 serves as a heat exchanger. It cools, as mentioned above, the mixture of oil and gasoline vapors down to the condensation point of the heavier constituents, and carries over the heat thus obtained into the fresh oil which is going to be cracked.

The highly viscous, heavy residue is removed continuously through the pipe 6 and the reflux cooler 7 into the tank F. The vapors reach the tower B. In this tower the constituents of the oil, which are of medium boiling point and which have not been completely cracked, are condensed, while exchange of heat takes place between these products and a flow of fresh oil on the way to the cracking stills. The aforementioned condensed products are then passed through the cooler 8 into the tank A and then returned to the process. The light vapors pass through the tower D, which is filled with Raschig ring-packing, and the dephlegmator G. There that portion of the vapors, which boils above the desired boiling temperature of the finished gasoline is condensed. These condensates pass through the gasoline condenser and cooler H in the gasoline tank K. The cracked gases which are formed during the cracking process separate out in the gasoline condenser H and pass through the pipe 9 into the gas holder. The amount of these gases obtained in this process is sufficient to cover the heat requirements of the cracking operation, or if they are not used for this purpose, they can be worked up into valuable by-products.

## OPERATION ADJUSTABLE

The amount of crude oil which corresponds to the production of the apparatus is continuously taken from the intermediate tank L and pumped through the pipe 10 to the tank A, from which it is removed as needed.

This process can be carried out in such a manner that the production of individual products can be adjusted to correspond to the market demands for them. Both the quality of these products, as well as the ratios of their quantities, can be regulated within reasonable limits, so that the best advantage can be taken of market prices and conditions. The adaptability of this process, which is claimed to be greater than that of any other process, depends on a very simple manipulation of a single valve and on the adjustment of the temperature which is accomplished in this manner. Instead of the necessity of driving the cracking to the formation of coke, it is possible to remove the residue in liquid condition from the process. This residue may possess any de-




sirable viscosity. Thus it can be used either as a raw material for the production of high grade asphaltic preparations or as a heating oil.

The possibility of cracking the oil in a continuous process without the formation of coke is accomplished by releasing the pressure on the cracked oil, which is subjected to high pressure in the cracking coils, and instantaneously reducing this pressure to 0.1 atmosphere after a definite calculated period of time has elapsed. At the same time the oil is cooled down by the introduction of fresh oil so that the cracking operation is instantaneously stopped. This prevents the undesirable continuance of the cracking up to the formation and deposition of free carbon. The portion of the condensate which contains a large amount of carbon, due to the liberation of hydrogen, is removed continuously from the apparatus.

Preliminary treatment of the material that is going to be cracked is secured by the admixture of the fresh material in the reducing valve of the tower C in addition to the desirable cooling of the cracked vapors. The addition of crude oil from the tank E is regulated in such a manner that the difference between the heat contents of the cracked oil vapors between the cracking temperature and the temperature of condensation of the heavy oil is sufficient to vaporize the oil to such an extent that only that portion remains in the liquid condition which has at the very outset too little excess hydrogen to be converted into cracked gasoline without the formation of carbon. It is thus possible in this way to obtain only such quantities of crude oil, which has not been previously treated, in the cracking coils which cannot be preliminarily distilled in the tower C, without lowering the temperature of the cracked vapors too far. The quantity of the oil that is directly introduced into the cracking coils is automatically regulated by means of a float valve in the tank A, that it corresponds to the quantity of the back-flow from the distilling tower D.

## NO LOCAL OVERHEATING

The speed at which the high pressure heating oil pump pumps the return flow of fresh oil mixture through the coil system of the cracking still can be increased in stages as the degree of heating increases. This speed is small in the preliminary heating zone, and is considerably increased in the actual cracking zone. Furthermore, the coils are arranged in such a manner that intensive, turbulent circulation ensues, which avoids any local overheating and therewith deposition of coke at simultaneously higher linear speed. The formation and deposition of coke would take place in spite of the preliminary distillation of the crude oil if a certain speed of flow were not attained. In a modern cracking process of this sort the coils are simultaneously heated, while the oil is protected in the best possible manner, by using a recirculation system in the flow of the heating gases.

The great amount of coke formed and deposited in the cracking processes which have been known and used up to the present time takes place not during the heating of the raw material up to the cracking temperature but during that phase of the process and in that part of the apparatus in which the oil continues under the influence of the pressure and temperature of the process for a certain period of time required for the formation of gasoline. The separated coke is deposited in that part of the apparatus (which is called the reaction chamber in most processes) and must be removed from it at certain definite time intervals. This is claimed to be the

main cause of the discontinuity of the American cracking processes.

This so-called stabilizing period is shifted to the actual cracking still in the Carburol process. A part of the system of cracking coils is used merely for maintaining the pressure and temperature condition that is attained in the cracking still. The length of the stabilizing coil is adjusted in such a manner that the effectiveness of the time factor is at its best. The temperature does not rise any more in this portion of the apparatus. The aforementioned relief of the pressure and interruption of the cracking process with cooling off of the cracked products by means of cooling oil take place immediately at the end of this period.

The correctness of the assumptions and statements that have been made above are substantiated by tests which were carried out on this process in a practical manner in an oil refinery located in Stuttgart, Germany.

It was also found that when the process was carried out for longer periods of time than those prevalent in experimental runs, no deposition of carbon could be detected, either in the cracking coils or in the reducing valve, the heavy oil separator, inside of the coils, the valve seat, etc., for all these parts remained perfectly clean. If the operation is carried out improperly or if the gross carelessness of the operating personnel allows partial overheating of the oil in the cracking coils to take place, with the result that separation of carbon takes place, even then it is found that the amount of carbon deposited is small. The process is not at all sensitive to its formation under the worst of conditions. Furthermore, the deposition of carbon within the cracking coils is immediately recognized by the registering controlling manometer, for the resistance of the cracking coils to the passage of the oil will be increased by the fact that the carbon mass will cause the inner area to decrease. When this happens, a means is provided whereby the coke can be quickly and completely removed from the coils with the minimum effort.

## PRACTICAL RESULTS

The results that have been obtained in the actual practical operation of the process clearly show its great adaptability. The flexibility of the process is particularly well demonstrated when cracking a gas oil. Thus the process may be first carried out for a long period of time so that a maximum yield of gasoline is obtained while the residue still remains in the liquid condition. Later, the simple manipulation of a valve produces a residue, which corresponds accurately to certain viscosity requirements. It happened in this case that the viscosity of the oil had to be kept within certain narrow limits in order to meet the requirements set for a locomotive fuel oil. Thus the viscosity in this case had not to exceed 20 degrees Engler at 20 degrees C.

The results which were obtained in the operation of the apparatus under these conditions are indicated below.

The gas oil treated had a density of 0.878 at 10 degrees C. The first period of production was devoted to the production of a miximum yield of gasoline and a thick heavy oil as the residue. The products obtained were as follows: Crude cracked gasoline, density 0.749 at 15 degrees C, 66.4 per cent by weight or 77.7 per cent by volume; a heavy oil, density 1.01 at 15 degrees C, 23.6 per cent by weight or 20.9 per cent by volume; gas, 10 per cent by weight or 1.4 per cent by volume. The second period of the operation was devoted to the production of a special grade of fuel oil as the residue. The products obtained under these conditions were as follows: crude cracked gasoline, density 0.745 at 15 degrees C, 52.1 per cent by weight or 61.4 per cent by volume; heavy oil, density 0.974 at 15 degrees C, viscosity at 20 degrees C 17.3 degrees Engler, maximum heating value about 10,000 calories, 37.8 per cent by weight or 34 per cent by volume; gas 10.1 per cent by weight or 4.6 per cent by volume.

Another interesting experiment was carried out on a blue oil (cerulignol) of Polish origin. The point here was to adjust the conditions of the operation in such a manner that a maximum yield of gasoline was obtained, the gasoline being of a certain quality, that is with a specific gravity of 0.745. This condition was fulfilled by the Carburol cracking process by simple regulation of the dephlegmator. The results obtained are given below.

The first period of the operation was devoted to the production of a heavy gasoline. The products obtained were as follows: crude gasoline, density 0.776 at six degrees C, 59.1 per cent by weight; heavy oil, density 1.001 at 20 degrees C 32.8 per cent by weight; gas 8.1 per cent by weight. The second period of the operation was devoted to the production of a light gasoline. The products obtained had the following characteristics: crude gasoline, density 0.745, yield 54 per cent by weight; heavy oil, density 1.04 at 20 degrees C, yield 33.6 per cent by weight; gas, yield 12.4 per cent by weight.

## ON HEAVY RESIDUES

Heavy residues, such as mazut and the like, are also processed in a continuous operation to obtain high yields of gasoline without the formation of coke. The following results were obtained with a mazut with a density of 0.898 at 15 degrees C: crude gasoline, density 0.764 at 15 degrees C, yield 45.8 per cent by weight; heavy oil, density 0.974 at 15 degrees C, viscosity 72 degrees Engler at 50 degrees C, yield 39.1 per cent by weight; gas, weighing 1.46 kilograms per cubic meter, 15.1 per cent by weight.

The apparatus that is used in carrying out the Carburol process may be divided into two parts, according to the physical-chemical operations that are performed in it, namely a high pressure part and a low pressure part. In contradistinction to the processes that are commonly used today for the production of cracked gasoline, the relatively high pressure of the Carburol process exists exclusively in a narrow coil system.

The design of the coils is such that reverse bends and collecting headers are used sparingly, and the total length of the piping is therefore divided up into only a few sets of coils. The connections between

these coils are made outside of the heating chamber and in such a manner that they can be easily gotten at and readily examined. Metallic packing is used in making the joints between the flanges and these have proven to be entirely satisfactory under the conditions of high temperature and high pressure that exist in the process. The aforementioned reducing valve is located at the end of the system of coils. This reducing valve acts in a very simple and effective method to relieve the pressure on the cracked oils that enter it under high pressure, the operation being entirely continuous. The actual pressure release takes place in the heavy oil separator. The latter apparatus and the reducing valve are built as units which are primary elements of the design of the apparatus.

The energy of the oils and vapors, which are emitted from the valve opening at high speed, is utilized within the valve by means of an ingenuous device to effect intimate admixture of the cracked material with a fresh cooling oil or with recovered oil that is returned to the apparatus. This mixing action accomplishes an intensive washing out of the high carbon constituents, in that the temperature in this part of the apparatus is adjusted in such a manner that all fractions, which boil above this temperature, are completely vaporized, and only the heavy boiling portions, which are unusable, are condensed. Gases and vapors are freed from the oil particles that are carried along by them within the heavy oil separator, this being accomplished by means of suitable baffles plates and the like built into the apparatus. The gases and vapors then leave the apparatus and enter the next in series, which is the so-called distilling column. The heavy oil separator itself and all the apparatus connected with it are no longer under pressure. It therefore follows that their construction affords no technical difficulties.

## APPARATUS NOT EXPENSIVE

Hence, the use of costly apparatus, which has to be operated under high pressure conditions, is not required in the Carburol process. It is advisable, from the standpoint of uninterrupted operation, that all the series of coils should be held in bearings, so that when it becomes necessary suddenly to replace these coils, the replacement can be accomplished within a period of a few hours.

The oil heating furnace is constructed in such a manner that each of the 12 to 16 series of coils can be quickly removed from the furnace by simply disconnecting the flanges, and the new coils can then simply be shoved into place.

The coils themselves are heated in a furnace of the most modern construction so that the maximum heating efficiency is obtained. This is accomplished in such a manner that the maximum temperature of the fuel gases is at a minimum. In spite of this, the efficiency of the apparatus is entirely satisfactory, this being obtained by using the principle of recirculation, so that the consumption of fuel remains a minimum. The process is watched and controlled in the best possible manner by the use of accurate instruments for regulating the temperature at various points in the furnace.

In order to attain maximum heat economy, the circulating oil is mixed with fresh oil by means of a fuel oil heating pump and is pumped by this pump into the furnace. This enables the heat to be retained in the system, and, aside from consumption of heat due to radiation and the consumption of heat for the cracking process itself, the only heat required is that necessary to bring the fresh oil and the already heated circulating oil up to the cracking temperature.

The construction of the remainder of the apparatus, which is used in this process, which includes the fractionating towers, condensers and the like, is no different from what is commonly practiced in the oil refining industry. There are no essential differences between the apparatus of this type that are used in the Carburol process and those that are commonly employed in other cracking and distilling processes.

The space requirements of the apparatus used in the Carburol process are very small, corresponding to the simplicity of the construction of the installation. Thus for example, the space requirements for an installation which is used to process one hundred metric tons of raw material within a working day is altogether 600 square meters. This also includes the furnace.

A further advantage of the process is that it allows small installations to be operated at high efficiency. The apparatus can be built in sizes to handle 30, 50 and 100 tons of raw material per day. There is, however, no difficulty in building a larger installation, for all this means is a duplication of units. It may be mentioned that the apparatus is made by the firm A. Borsig G.m.b.H., Berlin-Tegel, Germany, and that it has been patented in all civilized countries.

# Preliminary Views of Steam Distillation As Applied to Charcoal Tests

By H. J. JONES[1]
*Union Oil Company of California*

IN considering the adoption of steam distillation to take the place of the generally used glycerine method, considerable explaining must be done to show justification for such a move. The most satisfactory method of determining the gasoline content of natural gas is by means of the fundamental analysis such as is afforded by the Podbielniak apparatus. However, the time and expense involved in the obtaining of analysis results is considerably in excess of that expended in determining results by charcoal. It is also admitted that the results obtained by charcoal are more or less inaccurate in comparison with an analysis, but at least from the standpoint of prorating the plant production they do give the information required. Even in absorption plant operation their use has been and will continue to be, to the small operator at least, the most convenient means of indicating absorption plant efficiency. Especially will this last item be true if the yields by charcoal are correlated against the yields by analysis. Granting that there is and will be a need for a charcoal test, there should be an equal approbation for any improvement of the equipment or method of operating.

The charcoal test was first used in the California oil fields 10 years ago and was introduced by Burrell and the Bureau of Mines as giving promise of being more desirable than the old absorber test in general use at that time. The acceptance of charcoal as a test medium was slow purely because nothing was known regarding the manipulation of such a test or the apparatus required. Men engaged in such work tell us that the handling of the test was very crude. Items that now seem commonplace to us had yet to be worked out. Notable among these was the use of a short, rather large diameter tube in preference to the 30-inch length of three-quarter-inch pipe as now employed. It was also true that the value of a thermometer placed in the charcoal to indicate the completion of the saturation of the charcoal was not discovered until several years later. Therefore it may be pointed out that the acceptance of glycerine for use in the distillation was not based on exhaustive tests indicating its superiority over steam, but merely because steam was tried out at that time and discarded due to the fact that the proper method of conducting a steam distillation was not discovered. Consequently glycerine was adopted and has been used ever since except in some cases where mercury has been employed to obtain a relatively pure sample of natural gasoline free from the contamination of glycerine and its by-products. Therefore in contemplating the substitution of steam for glycerine in the distillation of hydrocarbons from charcoal the move should be considered merely the culmination of constant endeavors to effectively use steam for this purpose and not as an attempt to discard one method for a totally different one of no greater desirability.

[1]Paper read before California Natural Gasoline Association, October 17, 1929.

## GLYCERINE BY-PRODUCTS

As an initial statement in the comparison of these two methods it is believed that the steam distillation has all of the advantages claimed by the glycerine charcoal test over the old oil absorber methods and in addition has some advantages that can only be credited to the charcoal test when distilled by steam. Of these advantages, probably the most notable is the possibility of accurately correlating tests of any mixture of hydrocarbons possible to test by charcoal, against an analysis of the same mixture. Of this more will be said shortly.

One of the most familiar failings of the glycerine distillation is the formation of glycerine by-products which merge with the gasoline in the condensate receiver and consequently indicate a false yield. Actually, in some distillations of certain gas mixtures this quantity of glycerine by-products has been frozen out and found to exceed 50 per cent. of the measurable volume. In comparison, the steam distillation produces nothing but gasoline and water, clearly separated in the condensate receiver. Also the production of glycerine by-products is apt to lead to some discomfort to the men in the laborotory when the apparatus is taken apart, especially as acrolin is distinctly an irritant to the eyes. Steam distillation gives no such trouble.

In considering the comparative cost of the two methods it is true the initial outlay for the laboratory equipment probably is somewhat higher for the steam than the glycerine. However, this discrepancy should soon be compensated for when the difference in operating costs is added. The cost of electrical energy is greatly overbalanced by the summation of the costs of glycerine and cleaning and replacing the charcoal after being contaminated by the glycerine. The first glycerine distillation decidedly lowers the adsorption qualities of the charcoal and considerable treating is necessary to effectively remove the contamination. In fact some companies replace the charcoal after one distillation. Whereas in the steam distillation indications point to the continuous use of the charcoal without further treatment, other than screening and drying, until shrinkage by crumbling necessitates the addition of new stock.

## COMPARISON OF METHODS

As before stated, probably the greatest advantage, as indicated by testing to date, lies in the fact that results obtained by steam distillation are more consistent, more easily correlated to the analyses results, and more readily adapted to absorption plant operation. The reasons for production of these more favorable results can be

found in a description of the part played by glycerine and steam in their respective distillations. However, before starting this description perhaps a statement should be made to clearly interpret the terms used in this paper. The term "light undesirable material" shall be interpreted as including propane and lighter; the term "light desirable material" includes "iso butane, butane and a portion of the pentane," and the term "heavier ends" includes the remainder of the pentane and all of the heavier hydrocarbons present in the gasoline. First, in considering the glycerine method, everyone is familiar with the actual apparatus and handling of same. Briefly, some 280 cubic centimeters of saturated charcoal are dumped into a retort of approximately 1000 cubic centimeters. To this charcoal approximately 125 cubic centimeters of glycerine are added and the mixture is heated by a gas flame applied to the bottom of the retort. Due to the fact that glycerine foaming has caused some trouble it is necessary to have the retort of such size that there exists a vapor space of some 600 cubic centimeters. Now, if the distillation is run to the specifications of the California Natural Gasoline Association, the apparatus is shut in and the pressure is allowed to build up to 30 pounds before opening to the regulator. This means there is a mixture of air and high vapor pressure hydrocarbons present in the retort and condenser while the temperature of the mixture is being raised by the application of external heat. Consequently, as the lightest desirable vapors leave the charcoal they enter a mixture of vapors in which their percentage composition is very low and naturally the partial pressures exerted by these desirable hydrocarbons in this mixture are of small magnitude. This means that condensation of these vapors in the condenser does not occur, but instead they are lost through the vent. Whereas in the steam distillation apparatus the retort is only of sufficient size to hold the charcoal charge and there does not exist a relatively large quantity of foreign material to dilute the mixture.

Instead the construction of the retort allows the placing of the charcoal in such a manner that the lower layer of the charcoal is saturated with the lightest hydrocarbons and the heaviest hydrocarbons are in the charcoal situated at the top of the retort. This is true because the retort is approximately 1½-inch I.D. x 10 inches long and stands in a vertical position. As the steam evenly penetrates each pore of the charge the lighter ends are blended with successive heavier vapors and, due to its own partial pressure in the retort, allows a high concentration of light blended condensable vapors to be released into the condensor. It is at this location in the apparatus that the use of steam produces such radically different conditions from those that exist in the glycerine distillation. For, as the mixture of steam and vapor is cooled to 33° the steam condenses to water and the concentration of the vapors becomes such that the partial pressures existing condense practically all of the material present. In fact, in the case of charcoal tubes saturated with plant discharge gas it has been noticed that a portion of the material collects in the condensate receiver is so light as to be unstable at 33° and 30 pounds, and in short evaporates from the solution to such an extent that ice crystals are formed on the outside of the glass. In contrast to this condition the vapors flowing through the condenser during the forepart of a glycerine distillation are totally composed of air, noncondensable hydrocarbons and small portions of desirable vapors. Consequently a large portion of the pentane, butane and iso-butane are lost through the vent because they are not concentrated in the condenser to permit the production of a zone in which their partial pressures are relatively high. Therefore it is evident that a distillation consistently condensing all of the desirable fractions, as the steam distillation does, may be correlated very nicely with the analysis results. Besides this evident discrepancy during the forepart of the distillation the glycerine distillation also merges its by-products with the condensed gasoline. This item for a charcoal tube saturated with discharge gas from an absorption plant does not give a materially erroneous result, especially as the yield obtained is still so low that its comparison with an analysis is of little or no value. However it has been noticed that in distillation of very rich gas the yields by glycerine may be just as high as those obtained by steam. This is probably true because the percentage of light materials in the charcoal is small and their loss is more than offset by the addition of the grycerine by-products to the gasoline.

## CONTROLLED APPLICATION OF EXTREME HEAT

In further explaining the present steam distillation it may be stated that the sole reason steam is now successfully used for this purpose lies entirely in the correctly controlled application of external heat. Earlier attempts consisted either in depending solely upon the use of wet or superheated steam or else by the use of gas fired retorts in conjunction with steam. Wet steam is successful during the forepart of the distillation in vaporizing the light material but fails in the latter part because of its inability to raise the temperature of the charcoal high enough to completely vaporize the heavier material.

It has been conclusively proven that wet steam, when introduced into a cold saturated batch of charcoal, will effectively supply sufficient heat to vaporize the lighter materials and will also, due to its own partial pressure, lower the partial pressures of the desirable vapors so that the evolution of these condensable vapors is very rapid following the period of the distillation during which practically all the propane and lighter hydrocarbons of high vapor pressures have been vented. Therefore by correctly applying external heat to supplement the heat furnished by the wet steam it is quite possible to complete distillation. This type of heat application results in a distillation characterized by a slow moderate heating in the forepart followed by a gradual temperature rise during the remainder of the time resulting in a final temperature of approximately 900° in the charcoal. Superheated steam on the other hand, is successful in providing high temperatures to drive out the heavier ends but fails because its temperature is too high to be used in the distillation of the light desirable material. In explanation of this last statement it may be said that too rapid heating of the charcoal results in a lowering of the volume of condensed gasoline. This effect is undoubtedly produced by the fact that in a rapid heating all grades of hydrocarbons are more or less simultaneously vaporized, and the resulting composition and velocity of the vapors passing through the

condenser is such that the light desirable fractions are not condensed but instead are lost through the vent. Also, an additive effect of this too rapid heating in lowering the condensed volume, is found in the mechanical carry-off of condensed gasoline through the vent line due to the increased velocity. Therefore the rapid heating of a retort can not be allowed if consistent yields are to be obtained. Considering the effects of superheated steam it can be seen that this medium cannot play a part in such a distillation unless it is used in conjunction with wet steam. That is, it would be possible to conduct a distillation more or less successfully, by first applying wet steam and then changing to superheated steam at some determined retort temperature. However this method presents operative difficulties and has never been seriously developed.

The application of this additional heat has been attempted by means of gas fired retorts but this method met with little or no success due to the serious obstacles presented in uniformly distributing the heat throughout the charcoal. Therefore the present apparatus utilizes electrical heating elements which totally enclose the retort and enables the operator to apply to an even distribution of heat as needed throughout the distillation.

In closing this paper the statement should be made that it is given with the sole purpose of introducing the subject matter enclosed. No results of comparative tests are given and no statements concerning same are to be given at this time. It is the intention of the association to have a second paper presented in a short time in which will be given all data deemed necessary to support present indications. Also at that time slides will be presented showing the construction of the apparatus and a description will be given of its use.

# Gas Capacity of Absorbers Dependent Upon Oil to Gas Ratio

By F. L. KALLAM[1] and C. C. STEWARD[2]

ONE of the important problems confronting the engineer in the design of a natural gasoline absorption plant is, "What size and how many absorbers shall we install?" Let us put the problem in concrete form and proceed with the discussion, which it is hoped, will point out the relationship existing between the oil rate and the gas capacity of the absorber.

Consider a proposed plant for processing five million cubic feet of natural gas per day at 30 pounds pressure. Submitting this data to the several manufacturers of such equipment results in absorber proposals agreeing quite well in the matter of size. One such proposal is accepted, together with the guarantee that the tower will successfully treat 6,000,000 cubic feet of the gas per day. The plant is eventually built and operated very satisfactorily on 5,000,000 cubic feet of gas. Several months later the gas flow increases to 5,500,000 feet, and the plant is adjusted to meet this new condition. It is now found that absorption oil is carried out of the tower, resulting in the conclusion that the maximum gas rate has been realized.

The plant superintendent or engineer, however, now recalls that the absorber was purchased for a maximum gas rate of 6,000,000 feet, and immediately starts an investigation to which the manufacturer is invited. It is found necessary to reduce either the oil or gas rate in order to prevent excessive oil entrainment by the gas. Further, the tower is found capable of satisfactorily treating the required 6,000,000 feet of gas providing the oil to gas ratio is properly adjusted, but this ratio is somewhat too low for the desired degree of extraction.

### GAS RATE DEPENDS ON OIL RATE

This brings us to the point that the maximum gas rate at any one pressure is entirely dependent upon the oil rate, a fact that seems to have received scant attention up to the present time. Almost everyone connected with a gasoline plant is familiar with the statement, "That tower is good for so many cubic feet of gas at such and such working pressure." Obviously such a statement is in error since the oil to gas ratio involved has not been specified.

The relation between the oil and gas rates for three different type towers is shown graphically in the accompanying figure. Here the actual gas velocities through the free area of the tower are plotted as ordinates and the corresponding oil to gas ratios as abscissas. The plot is self-explanatory, each curve representing a tower differing from the others only in the design of bubble cap, overflow and seal. In obtaining these data, complete testing facilities were available, including residue gas scrubbers which permitted the immediate detection of oil being carried from the towers by the gas. The points determining the position and shape of the curves were taken so that the oil to gas ratios were maximum for any

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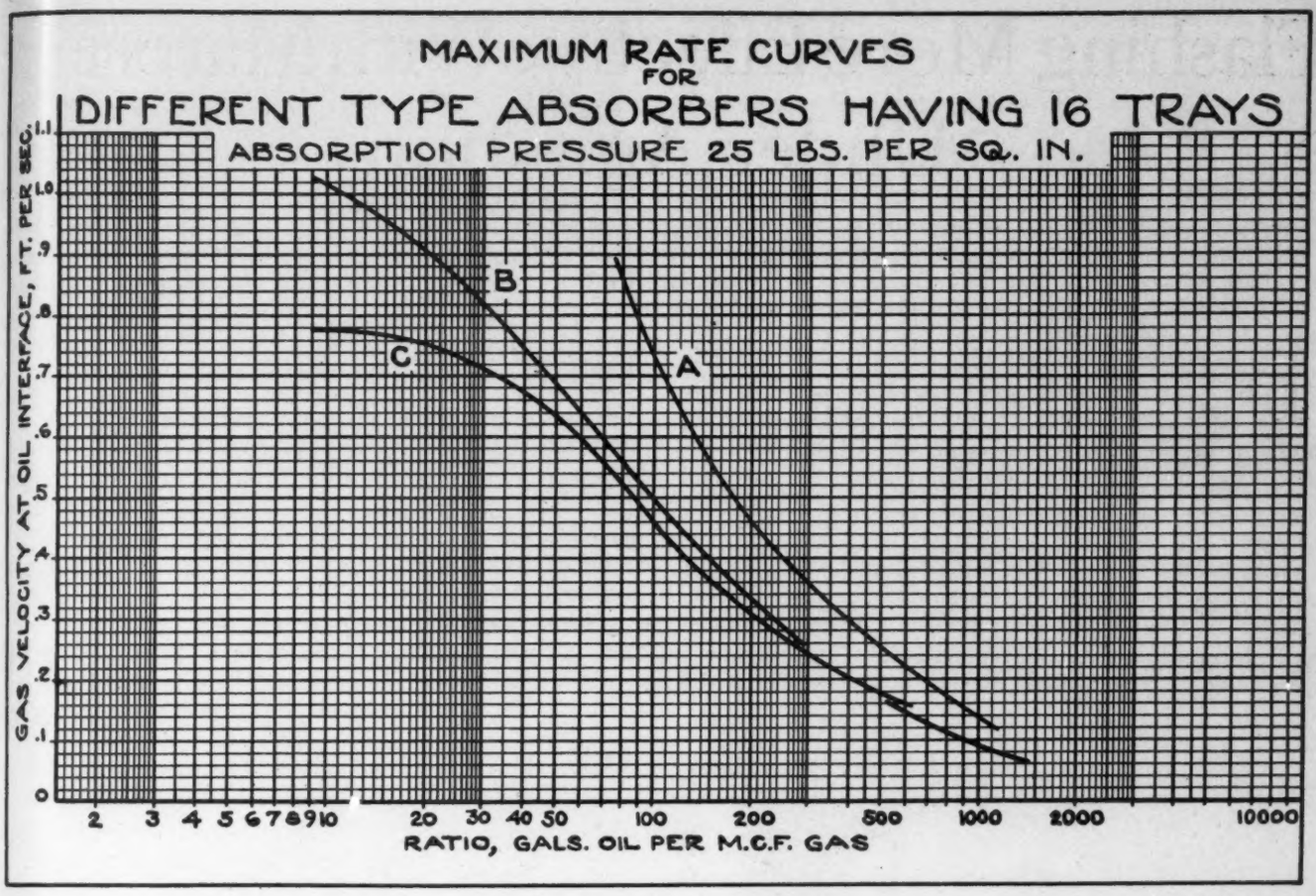



given gas velocity through the towers. Increasing the ratios beyond these values resulted in pronounced oil misting.

For example, let us say that the tower under consideration has a cross sectional area such that in passing 5,000,000 cubic feet of gas per day at 30 pounds pressure the gas velocity is 0.6 feet per second. From "Curve C" we find that for this type of tower and a velocity of 0.6 feet per second it is allowable to circulate a maximum of 60 gallons of oil per 1000 cubic feet of gas treated, or 300,000 gallons of oil per day. In this tower it would not be practical to use a higher ratio on account of the accompanying oil entrainment in the residue gas. On the other hand, the oil to gas ratio can be increased to 100 providing the gas velocity is first reduced to 0.46 feet per second. Conversely, increasing the gas velocity to 0.7 feet per second permits us to use an oil to gas ratio not exceeding 34 gallons per thousand cubic feet of gas. For velocities higher than 0.7 feet per second we see that the maximum allowable oil rate decreases rapidly and finally reaches a point at 0.78 feet per second where a very small amount of oil circulated causes entrainment. Obviously, the gas capacity of an absorber at a given pressure is dependent upon the quantity of oil circulated under these conditions.

## MAXIMUM GAS VELOCITY

In order to more clearly visualize the effect of oil rates on the maximum gas capacity of an absorber, let us picture a sealed bubble tray tower operated at atmospheric pressure with zero gas velocity. A small amount of oil is now circulated over the tower and the depth of oil on each plate noted. As this rate is increased, the depth of oil also increases, and we reach a point where the oil level is perhaps two or three inches above the downpipes. If, at this point, gas is introduced into the tower, entrainment will be pronounced for the reason that the gas must suffer a pressure drop equal to the height of oil above the tray as well as the friction drop through the gas flow nipples. This combined pressure loss being greater than the effective oil seal at each downspout, the oil is unable to follow its regular down course and continues to build up on the tray, eventually resulting in loss of oil from the tower.

This means that the maximum allowable gas velocity is a function of the pressure drop across the trays, and this pressure drop may be due to:

a—Excessive head of oil on the tray which the gas must overcome as in the case of low gas rate and high oil rate.

b—Normal head of oil on the tray with a high gas rate, the pressure drop here being largely due to friction loss by the gas in passing through the flow nipples.

c—Combinations of (a) and (b).

The accompanying curves should not be used as a basis of comparison for other towers, for each different tower will have an individual curve depending upon its various characteristics. The slope of the curves, however, will be very similar, showing the interdependence of the oil and gas rates.

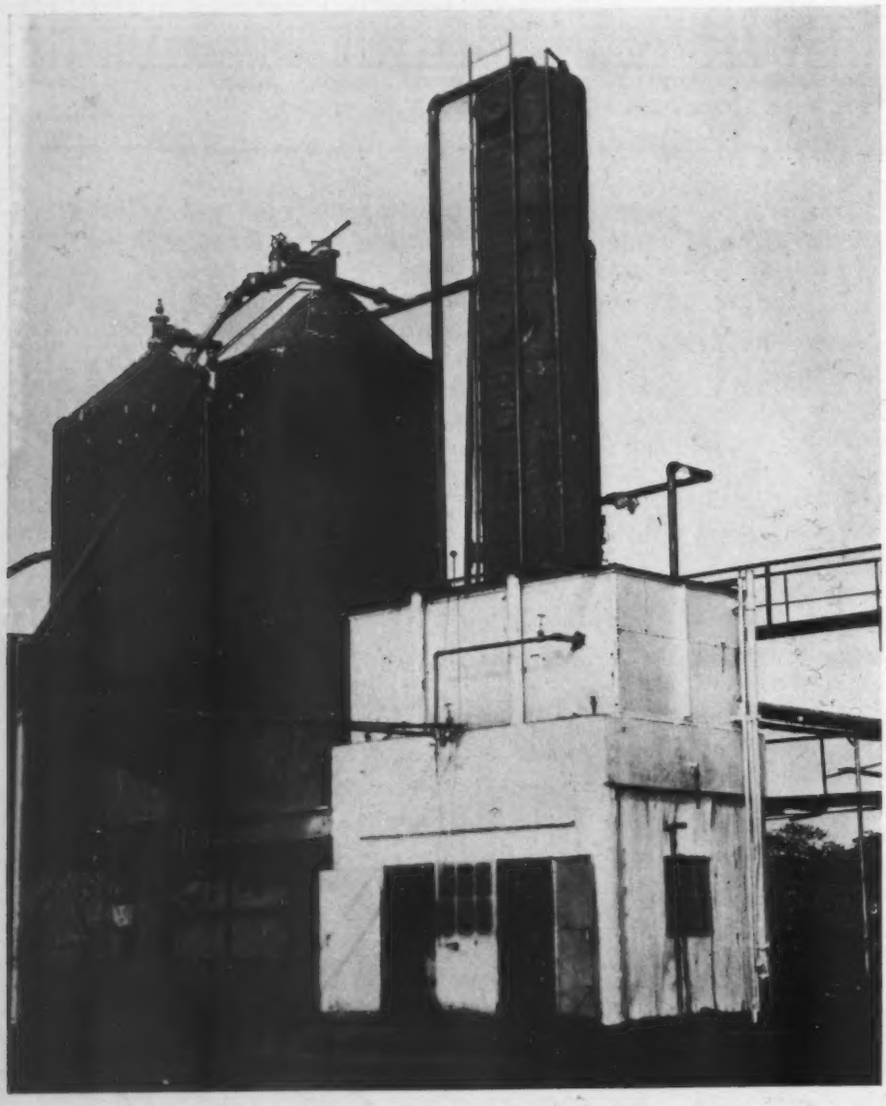
# Flashing More Effective With Materials Under Agitation

By GEORGE REID
*Associate Editor*

THE skimming and cracking plant of the Louisville Refining Company consists of a tube still of 3500 barrels daily capacity and two Dubbs cracking units, with the required auxiliary equipment and departments necessary for the production of gasoline, kerosene and furnace oils. Fuel oil production is consumed at the plant.

This plant was originally a cracking plant consisting only of the two Dubbs units and a shell still for redistillation of the pressure distillate. Later the Winkler-Koch tube still and bubble type fractionating equipment were added. The present owners began operating the plant in May, 1928, after an extensive program of reconditioning and improvement. This program has been followed throughout the past year with the view of securing better efficiency and economy of operation. Operation of the property is directed by C. A. Jouett, general superintendent. G. C. Hatfield is assistant superintendent in charge of the skimming plant, and R. E. Allison is assistant superintendent in charge of the cracking department.

One of the interesting developments at this plant during the past year has taken place in the cracking department where an improved flashing system has been perfected. The earliest attempt to utilize the heavy residuum from the Dubbs cracking units at this plant consisted of a series of settling tanks with conical bottoms in which the residue was caused to settle in an effort to separate the suspended carbon from the oil.

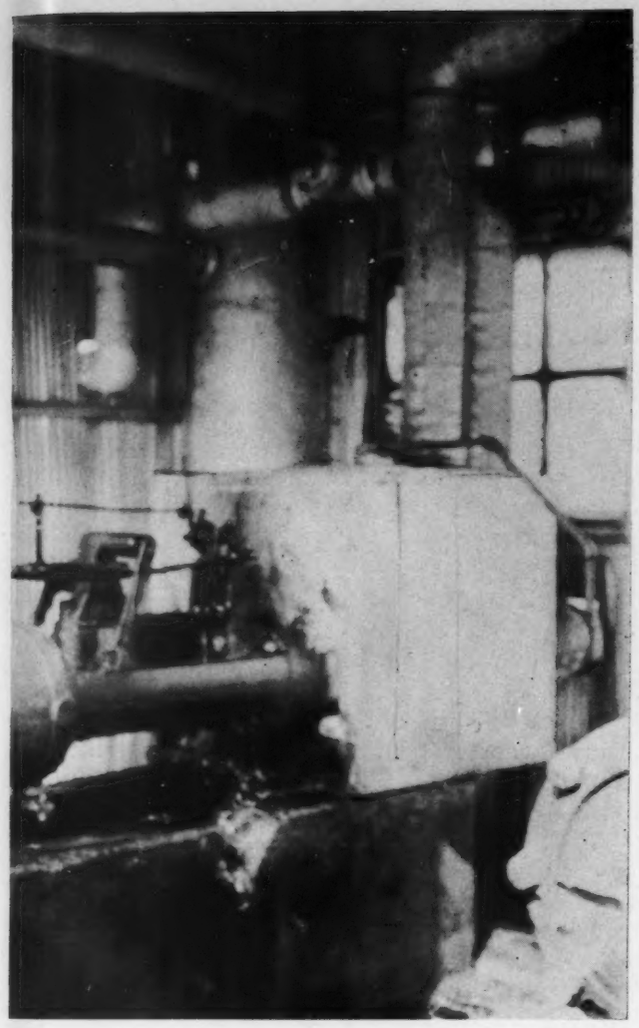


*Flashing system at Louisville Refining Company's cracking plant of improved design and economy. Fuel oil from this system is used under all stills*

Mr. Jouett and his assistants decided to install a flashing system instead of using the settling method. The first flashing method consisted of utilizing four of the old settling tanks by riveting them together in pairs, thus providing flashing chambers at very little cost. The residuum is drawn off the Dubbs chambers continuously to flash into one or the other of the flashing chambers. Steam is passed into the drag line continuously, and when steam and heavy residue reach the flash tanks a stream of gas oil is flashed off. In this system, which is now improved, the gas oil was condensed and recracked or marketed as furnace oil.

## AGITATION AIDS FLASHING

There were certain disadvantages in the operation of the first flashing system. In the first place the gas oil flashed off was found to contain some valuable lighter material which could be fractionated easily and re-run for gasoline yield. Also this practice would yield a better furnace oil from the base of the fractionator. In addition the flashing chambers rapidly filled with coke and outlet lines from the flash



*The oil end of each of the hot oil pumps are insulated by means of a rectangular metal case filled with loose asbestos*

tower where the pump suction withdrew the heavy fuel oil were inclined to plug up easily. Three outlet lines were provided at different levels to offset this disadvantage, but even so, the period of continuous operation was not sufficiently long to satisfy the operators. The problem became one of lengthening the cycle of operation of each of the flashing towers.

One of the first steps was the installation of a recirculating line in the towers and the utilization of one of the two Worthington hot oil pumps, size 10 x 4½ x 10, in the work of circulating hot residuum through the towers. This pump takes suction at the upper level of the oil in the flash towers and discharges into the cone at the bottom. In this manner the oil and coke are kept in agitation while being flashed with the steam coming into the tower through the drag line with the residuum.

This recirculation system has led to the maintenance of more even temperature in the flash tower. The recirculating lines are heavily insulated. Also the oil end of the pump is encased in a rectangular metal box containing loose asbestos which reduces any loss in temperature at this point. Such insulation is both efficient and simple in application and can be easily removed when pump repairs are necessary.

In the event that coke settles near the fuel outlet lines and causes either pump to lose suction, the manifolds are so arranged that the flow can be reversed and pumps will discharge against the coke, throwing it back into the center of the flash tower.

## FUEL OIL CONSUMED

The fuel oil suction is placed about the middle of the height of the flashing tower. A second hot oil pump of the same type and size is employed to circulate the heavy fuel tar to the burners. An extra heavy 1½-inch line leads from the pump to the Dubbs furnace burners, to the re-run still and to the pipe still burners and back again to the flashing tower. The pump handles this heavy tar at 600°, building up a pressure at the pump of around 100 pounds. In this manner all of the fuel oil is consumed at the plant. Further fuel economy is seen in the utilization of Dubbs unit gases for firing the four Walton 150 horsepower boilers in the power plant, when the cracking units are operating. This is supplemented by gas fuel from city mains when cracking coils are shut down or provide insufficient fuel.

The product of the flashing operation is carried away through a six-inch vapor line into a tower packed with various sizes of brick. There is six feet of whole brick in the bottom of the tower and about 5½ feet of smaller chunks of brick placed above that. The flashed vapors enter the tower near the bottom where cooling causes the condensation of the heavier fraction which accumulates as reflux, passes through cooling coils and to storage. This material is about 15 gravity, having a 230 flash and 250 fire point. It is zero cold test and is said to have about the same B.t.u. value as fuel oil from the same Kentucky crude. It is marketed as fur-

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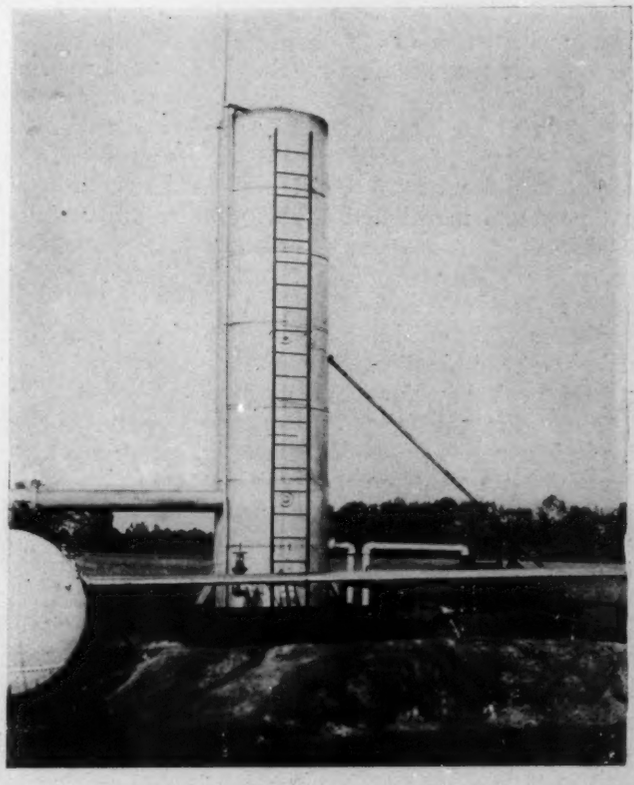


*The new blow-down apparatus at the Louisville Refining Company plant which reclaims all of the oil, stops offensive odors, and eliminates the dirty area around the blow-down pits. Horizontal surge tank or receiver is shown at the left*

# New Equipment Converts Old Plant Into Modern Unit

By GEORGE REID
*Associate Editor*

OHIO VALLEY REFINING COMPANY of St. Marys, West Virginia, in March, 1929, completed a program of improvement in various departments of its plant, including the installation of two Foster-Wheeler pipe stills and modern bubble type fractionating columns. The crude distillation unit is designed to run down to high flash point cylinder stocks or flux bottom, if preferable, taking off through a fractionating tower, 106 feet in height, seven side stream of various type products such as 68/70 gravity gasoline, naphtha of and desired specification, kerosene distillate, gas oil, pressable wax distillate, a centrifugal overhead cylinder stock together with a heavy cylinder stock bottoms with flash ranging from 630° to 660°.

The second and smaller pipe still is designed to reduce pressed distillate from the wax department and wax free oil from the centrifugal plant, as well as rerun pressure distillate, alternating between the products as required. These additions increased the plant operating capacity from around 1000 barrels daily to more than 2000 barrels. Other improvements include additional steel storage roofed with the latest improved type of Wiggins roof, enlarged centrifuging capacity, and a new 10-hearth Nichols-Herreschoff fullers earth burner. Completion of this construction program converts this 15 year old plant into one of the most modern installations in the Eastern refining district.

The plant operates on 42/44 gravity Eureka and Buckeye crude, recovering to specifications in a single operation and in continuous streams, the several products mentioned above. These are variable at the will of the operators to meet different market conditions. Simplicity is the outstanding feature of the installation since only the usual three systems or phases of operation are included in its design, such as the main heating unit, fractionating tower and the preheating and cooling system.

Crude through the heating unit is preheated through a series of exchangers. The first heat exchange is secured from the gasoline vapors by means of a large exchanger inserted on the vapor line. Gasoline vapors passing downward through the exchanger at a temperature of around 200° preheat the crude sufficiently to cause the dropping out of salt and other foreign matter. These vapors, after giving up most of their heat to the crude, pass to a second exchanger just below, where they are condensed by water. Final cooling is secured in Sterling cast iron condenser sections submerged in the conventional tank type box.

## PREHEATING EQUIPMENT

The preheated crude oil passes through the salt settler and onward through a series of three large heat exchangers which are designed with low pressure drop to obtain a gravity flow of the fractions employed for heating through the exchangers and coolers to run down storage. The side streams withdrawn from the various sections of the multiple stream tower, which are employed for heating the crude, are gas oil, wax distillate, and overhead cylinder stock fractions. The crude is preheated in this manner to about 350° before it enters the Foster tube still.

The tube still is made up of three-and four-inch tubes, all of which are protected from flame impingement, the roof tubes being heated by radiant heat. Crude is charged to the unit by Worthington duplex pumps, one being stand-by equipment, and size 9x4½x10 inches. All pumps, in fact, are in double sets, for charging, rerun, and reflux or trim pumps. The still is gas fired and provided with all essential instruments for automatic regulation.

In passing through the tube still the oil is heated to 710°, higher or lower, depending upon the required specifications of the cylinder stock bottoms. Cracking is avoided by means of the velocity of the oil passing through the tubes, the heating being accomplished in minimum time to prevent overheating or any cracking. There is also a superheater in the still to superheat the exhaust steam pumps which is later used in various sections of the tower as a aid to distillation and fractionation.

The oil then passes into the bottom of the multiple compartment bubble tower where the heavy cylinder stock is removed from the bottom section throught exchangers, cooling coils and to storage. This tower is five feet nine-inches in diameter and 106 feet high. There are seven sections of varying heights, and a total of 48 bubble trays in the tower. The number of trays varies with the given section, depending upon the type of material to be removed. One section, provided for the removal of a wax slop cut, is not utilized, so the tower is employed to make but five side streams in addition to the bottom and overhead cuts.

## FRACTIONS REMOVED

After removal of the bottoms, or heavy cylinder stock, the next stream from the bottom of the next section upward, is an overhead, 540 flash cylinder stock which is pressable as it comes from the tower. It is not cracked, but is taken directly to the mixing tanks, put into solution with 60 per cent naphtha and dewaxed in the centrifuge plant after chilling.

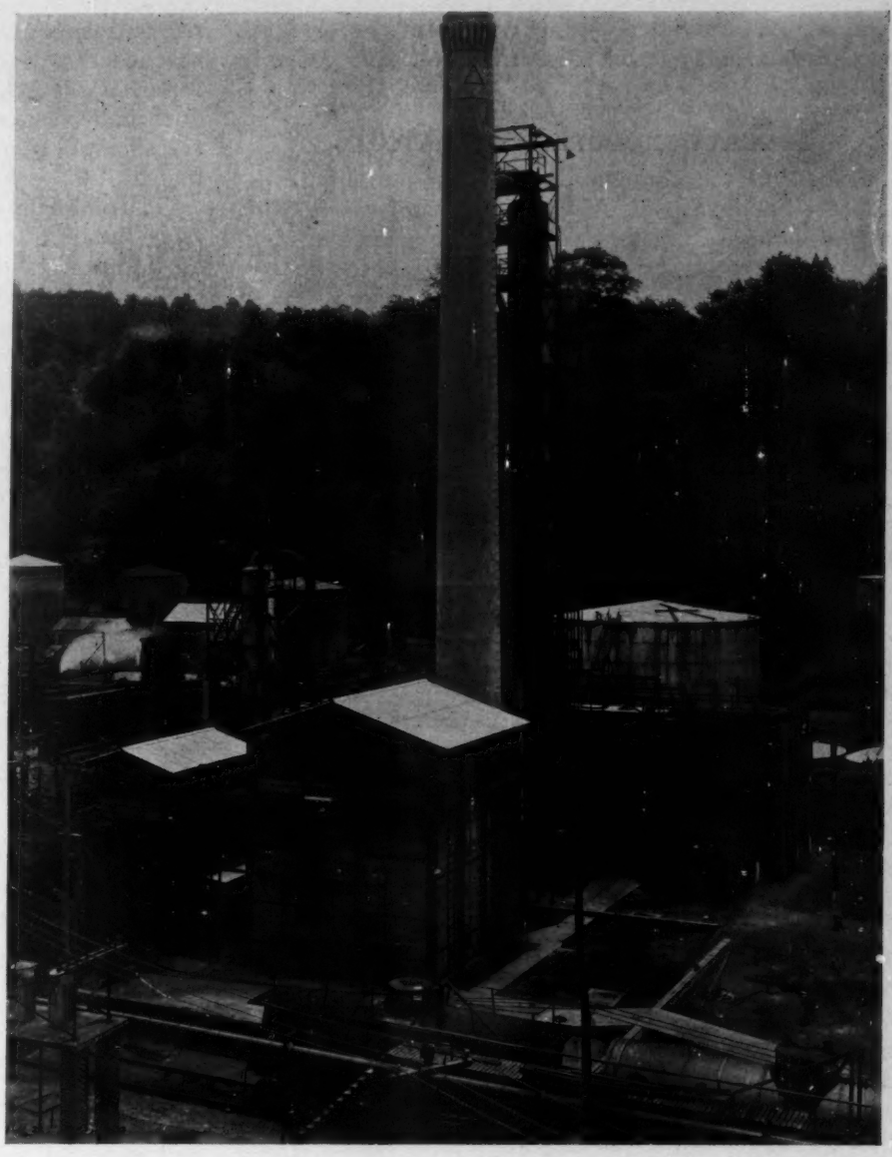
The next fraction removed is a side stream of wax distillate. This product is also pressable without

further treatment such as cracking. The preparation of pressable fractions by means of the tube still and bubble tower is one of the chief factors contributing to low cost operations through the elimination of the old system of cracking to make wax bearing distillates pressable.

Gas oil is the next side stream taken from the tower, which naturally requires no further processing but is simply pumped to the cracking department and charged to the Conerty-Snodgrass units.

Above the gas oil section the kerosene distillate accumulates and is withdrawn from the tower. It is usually finished to specification in this operation, but may be further processed to meet specifications other than those for which the tower was designed, which may become profitable when market conditions for kerosene point to the advisability of redistilling this side stream. About 15 per cent of the crude charge is recovered as kerosene. Approximately 14 per cent is gas oil. Twenty five per cent of the crude charge constitutes the average lubricating oil fraction.

From the bottom of the uppermost section a stream of naphtha is withdrawn which amounts to about six per cent of the crude charge. This production may, of course, be varied at will, due to the flexibility of design, and naphthas of varying specifications may be produced. The same is true of the overhead gasoline stream. When the tower top temperature is controlled to about 200° the overhead cut of gasoline amounts to around 38 to 40 per cent of the crude charged to the unit. The usual practice is to produce an overhead stream to current market specifications for motor fuel and remove naphtha from the bottom of the tower for use in the preparation of solvent for the dewaxing process, or to meet painters naphtha requirements.



*General view of the Ohio Valley Refining Company's new crude oil distillation plant and the rerun unit. The bubble tower working in conjunction with the larger pipe still is 106 feet in height and is designed for the removal of six side streams, one overhead vapor stream, and the cylinder stock bottoms fraction*

## PRESSING REVERSED

Wax distillate formerly produced by shell still operation at this plant was of such character that it pressed better, or gave up its wax more easily, only when handled fresh, and the fresher the stock was, the better the result. Since the new unit has been installed the operators have found conditions just the reverse, and the longer the wax distillate stands before pressing, the more easily is the wax removed from the oil. The practice is now to let the wax distillate stand in storage for a while before taking it to the wax plant.

The wax plant consists of two Carbondale refrigerating units, of 75 and 50 ton capacity, one of which is employed in chilling oil-naphtha solution for the centrifugal dewaxing machines, and the other for the convention wax pressing operation.

The refinery is provided with an absorption type gasoline recovery plant. Run down tanks are all roofed with concrete. The yard is well lighted at night by means of four 100 Watt lamps mounted 110 feet above ground at the corners of the safety working platform at the top of the fractionating tower.

The smaller rerun pipe still consists of a Foster tube still with integral steam superheater and a bubble tower. This tower is provided with means for the removal of one side stream, an overhead vapor stream and the bottoms fraction. It was designed primarily to redistill 500 barrels per day of pressed wax distillate, recovering gas oil overhead, a 100 viscosity neutral oil side stream and a 200 viscosity bottom fraction. It is also utilized to rerun cylinder stock solution recovering the solution naphtha as an overhead stream and cylinder stock or bright stock bottoms. The unit is sometimes employed to rerun

pressure distillate, recovering end point motor fuel overhead, a side stream of furnace oil and gas oil bottoms.

### CONERTY-SNODGRASS OPERATIONS

Since 1921 this company has had three units of the Conerty-Snodgrass cracking system and while the process is not of great commercial importance it may prove of interest to note some of the features of the units.

It is probably one of the simplest forms of cracking. The individual unit consists of a shell still, vapor lines, a harp-like dephlegmating devise, a relief valve, accumulator tank, meter, look-box and run down lines to pressure distillate storage tanks.

Each shell still has a charging capacity of 300 barrels and each unit is operated about three days, being batched down. That is, one unit is charged every three days. After they are on stream the units produce enough gas to fire themselves. They are operated at 75 pounds pressure at this plant, and final temperature is 750 degrees.

Gas oil of 36/40 gravity is charged to the units. About 65 per cent of the charge is taken over head as pressure distillate. The gasoline percentage of the pressure distillate is around 65 per cent which nets back to approximately 40 per cent recovery of gasoline from the charging stock. The pressure distillate is acid treated, neutralized, and redistilled in either shell still apparatus or the small rerun tube still unit. Bottoms from the cracking units are marketed as furnace oil.

## Flashing More Effective With Materials Under Agitation

(*Continued from page* 65)

nace oil. It is said that this stream represents about six per cent. of the initial charge to the Dubbs unit.

The lighter vapors ascend the packed tower and are conducted to condenser coils and to storage. This stream is about 54 gravity and contains around 70 per cent. gasoline. It is taken to the pressure distillate storage tank, blended with it, and chemically treated and re-distilled for recovery of its gasoline content. The volume of this 54 gravity material is said to represent about 1½ per cent. of the initial charge to the cracking unit.

Through the changes and improvements as outlined, the operators have succeeded in producing a better furnace oil, in increasing the recovery of gasoline from the cracking units, and have lengthened the cycle of operation of each flashing tower from a few days to such long runs as 15 to 25 days, between clean-outs. Clean-out periods come, of course, when the flash towers become filled with larger chunks of coke to the extent that fuel oil can not be withdrawn and pumped to the burners.

### BLOW-DOWN DEVICE

Another recent development of interest is found in the newly installed blow-down device which eliminates the old type of concrete blow-down well used in connection with the Dubbs unit operation. The new tank-and-tower blow-down receiver has eliminated the waste of oil, greatly reduced the objectionable odors from the plant, and is conducive to cleanliness.

The apparatus consists of a horizontal tank or receiver into which the cracking units are blown-down, and a tower, open at the top, over which water is sprayed when blowing into the receiving tank.

One line from each cracking unit runs to the side of this horizontal receiving tank. These lines come from the tube bank, and drain the reflux and hot oil pumps. A third line is provided leading from the safety relief valves at each unit. The receiving tank is four inches lower at the draining end so that all hot oil received will flow to the outlet. Also, at this lower end, there is provided a six-inch screw cap forming a gauge hatch for inspection to be sure the receiving tank is free of oil or water before use. Safety relief valves are also provided on this tank and a pressure gauge. A gauge glass is provided at the pumping-out end to indicate the level of oil in this surge tank.

### OIL SAVED

Leading from the horizontal surge tank are two 10-inch vapor lines which conduct any vapors from the hot oil into the bottom of the tower. The tower is provided with 23 inclined baffles which extend about three-fourths of the diameter of the tower and are placed in alternate position. Each of the baffles is punctured with a large number of one-inch holes. Water is sprayed over the top of this tower when in use and effects the condensation of the oil vapors rising from the bottom inlet from the surge tank. Condensed oil and water fall to the bottom of the tower and overflow to sewer and trap, where the oil is reclaimed.

When water is being pumped into the reaction chambers to cool the coke. The line leading from these chambers to the horizontal surge tank is closed or blocked off at a point near the tank. A lead-off line is opened leading directly into the bottom of the water sprayed tower. This precaution was taken for the reason that operators sometime overflow the chamber when injecting water and a sudden shot of water from the chambers to the surge tank containing hot oil from the blow-down operation would possibly couse explosion. Through this means any water from this source would pass harmlessly into the bottom of the water sprayed tower.

The oil reclaimed in the surge tank or horizontal receiver is pumped out first into an old cone bottom tank formerly used in the settling system previously mentioned. After it settles here for a while it is pumped into the Dubbs charging stock tank and re-cracked. The average recovery of oil per blow-down is said to be around 30 barrels, which was wasted many times when the old blow-down pit method was employed. The new method has eliminated the dirty oil soaked area around the blow-down apparatus and has stopped complaints from the residential district of Louisville located nearby.

# Principles of Installing and Testing Orifice Methods

By R. A. BOYD
*Columbian Gasoline Corporation*

IT might be well to give a brief description of an orifice meter and the principle of operation before entering into a discussion of installing and testing.

A mercury float differential gauge is primarily a U tube constructed of semi-steel and steel in which mercury is used as a seal. A cast iron or steel float is placed in the high or low pressure column and is connected by a lever and shaft working through a stuffing box with the pen arm. The pen of the pen arm records the differential or difference in pressures on either side of the orifice on a revolving chart which is driven by a clock.

Orifice meters are installed singly to measure fairly uniform flows of gas or in multiple if the maximum to minimum flow exceeds the capacity of a single meter. A combined installation of a 10-inch and a 100-inch meter increases the capacity 3¼ times.

There are two methods of making the meter connections to the line, that is flange connections and 2½ and eight pipe diameters from the orifice.

If flange connections are used the meter lines are connected directly to the orifice flange.

If 2½ and eight connections are made the high-pressure side of the meter is connected 2½ times the diameter of the pipe upstream, the low pressure connection being made eight times the diameter of the pipe down stream. This difference in the method of connecting the meter to the line will make a difference in computing charts of approximately one per cent. on the smaller sizes of orifices up to 33 per cent. with the larger sizes. Meters and flange connections giving higher readings than 2½ and eight connections therefore necessitating larger coefficients for the 2½ and eight than for flange connected meters. When 2½ and eight connections are used, the upstream pressure is recorded and the downstream pressure is recorded when flange connections are used. Flanges should be installed as far away from compressors, pumps and regulators as possible and meter lines should be as short between the flange and meter as possible to assure accurate measurement. Long lines usually give low readings.

An orifice flange union should be screwed into the line with a straight pipe the same size as the orifice flange at least 16 times the diameter of the pipe each side of the flange without any fittings. The flange can be installed at any angle but care should be taken that the meter connection outlets are in such position that dirt, water or other foreign substances that are carried along the line with the gas or liquid will not settle in them.

The orifice plate should be installed so that the data on the handle can be easily read.

The orifice meter is one of the simplest methods of measuring gas or liquids, but to get best results intelligent care and frequent test should be made on the meter to be sure that it is working properly. There is no definite time interval for making these tests as the conditions surrounding meters vary so widely. It can readily be seen that a meter measuring wet, dirty gas should be tested more often than a meter handling dry, clean gas.

The tests on a meter are usually made with an ordinary mercury U gauge, this being connected to the high or low side of the meter, depending on the service the meter is being used for, that is pressure of vacuum. The opposite side of the meter to which the U gauge is attached is opened to the atmosphere, then the valve in the line leading to the side of the meter to which the U gauge is attached is opened slightly, provision being made in this line to bleed to the atmosphere, and the pressure or vacuum on the line is used to establish a differential reading simultaneously on the recorder and the U gauge. The recorder and U gauge should agree at all points throughout the range of the recorder.

Care should be taken to allow time for recorder to balance with the U gauge as the U gauge moves very quickly and the recorders are so constructed that they have a dampening action.

If a recorder is to be checked very accurately, a water column of sufficient range should be used as with the magnified or larger scale of the water column much more accurate readings can be made.

We will enumerate some of the troubles which are found when meters are tested and the method of correcting them when they are found to be fast or slow, that is the reading on the recorder will either gradually lag behind or gradually increase above the U gauge reading. This can usually be corrected by lengthening or shortening the lever which connects the float to the pen arm shaft or possibly the pen arm has been sprung to where the pen does not follow the hour lines between the 0 and maximum range line of the meter. This usually causes the meter to gain and can be corrected by making the meter arc properly.

Again the pen will move in steps, this is usually caused by a sticking shaft in the stuffing box and can be corrected by changing the stuffing box and shaft if it is badly corroded or by clearing same.

Sometimes it is found that a meter is reading too high or too low, and apparently the meter is in perfect adjustment; when this happens it is usually found that the meter lines are leaking or have some foreign substances in them.

# Phillips Stabilizing Plant At Houston Operating

PHILLIPS Petroleum Company's new fractionating and stabilizing gasoline plant on the Houston Ship Channel, at Houston, will be in operation early in November, according to J. K. Gibson, construction engineer in charge. Present plans of those in charge of construction and operation at the plant call for an export shipment of gasoline the first week in November. The layout of the plant, which will be used exclusively for fractionating and stabilizing gasoline, embraces a Tulsa type, high-pressure fractionating column for the distillation of gasoline, a hypochlorite plant for doctoring sour natural gasoline, tanks, spheroids, loading and unloading pumps and a 30-car loading rack.

Natural gasoline is brought in to the Houston plant of Phillips Petroleum Company in tank cars from Oklahoma and West Texas and unloaded at the rack by Goulds six-inch centrifugal pumps. One Goulds four-inch centrifugal pump serves to unload that portion of the gasoline destined for the treating plant. To receive the sweet oil there are 60 horizontal tanks of 22,000 gallons each, while 20 of the same tanks are reserved for the sour stuff. These tanks are arranged in two batteries of 40 each — 30 in each battery being for the sweet oil and 10 for the sour. The sour gasoline is taken by a Westco centrifugal pump, directly connected with a seven horsepower Wagner motor, which discharges it by way of Fullers earth filters to the hypochlorite treating plant. The hypochlorite treating plant consists of one agitator, three treaters and two settling tanks, the equipment necessary for preparing the sour natural gasoline for the fractionating column.

Fractionating equipment takes suction from two Chicago Bridge and Iron Works spheroids. The suction is generated by two horizontal Dean pumps which discharge by way of heat exchangers to the Tulsa tubular type fractionating column. Coming out of the fractionating column butane free, the product is delivered to the 80,000-barrel storage tanks, each of which is equipped with the Wiggins breather top, safety valve and fire screen.

Tail vapors from the fractionating column are delivered through a Tulsa type intercooler to the final accumulator. The accumulator's line to the storage batteries is equipped with a 6 x 5 x 12 Dean pump.

As to the power plant, heat for the kettle is received from three 75 horsepower Oil Well Supply Company field type boilers. These are automatically controlled, having Copes water level controls and pump governors, with Neilan regulators on the fuel feed.

*J. K. Gibson, construction engineer in charge of the Phillips Petroleum Company's fractionating and stabilizing plant at Houston*

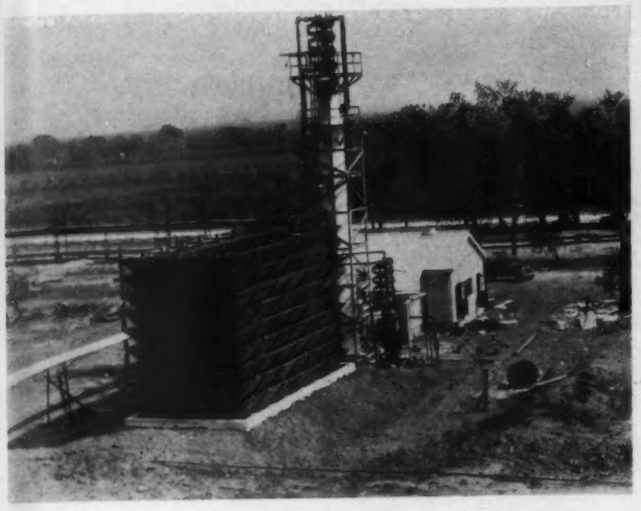
In connection with the boiler plant, a rather interesting safety precaution has been taken. The plant has been circled with two half-inch pipe lines, running in parallel. One of these is empty and the other is filled with gas. At convenient places, the two lines have been connected with standard nipples. Set midway in each nipple connecting the two parallel lines is a Merco-Nordstrom stop valve. By opening one of these valves, in case of a fire emergency or in case of sudden appearance of a fire hazard, pressure from the charged line is transmitted to the empty line. The pressure is thus admitted, through the heretofore empty line, to the diaphragm of the Neilan regulator. This cuts off the fuel supply to the boilers and causes the steam snuffer lines to open on the fire in the boilers, thus extinguishing the fire.

Another interesting development in connection with the boiler plant is the means employed by Mr. Gibson for boiler foundation installation. Heretofore a great deal of trouble has been experienced with crawling tendencies, where the oil field type of boiler was employed in gasoline plant heat generating departments. This tendency renders permanent insulation impossible and plays havoc generally with conservation of steam, as a crawling boiler means loose fittings. To get around the usual condition and still benefit from the economy of the field type boiler, the foundation was re-inforced with steel rods and angle irons. On each corner of the foundation an angle iron served as a binding cornice, being laid on the perpendicular edge of the brick foundation corner. The angle iron measures roughly about 15 inches on the perpendicular, with about a two-inch angle leg extending well over the corner of the foundation in each direction from the corner. These uprights are tied together with three-quarter-inch rods, running from corner to corner. One rod is placed near the top of the angle iron and another near the bottom. This gives a rigid re-inforced frame for the boiler foundation. It might be better if some way could be worked out to employ the triangle feature for bracing with the rods and angle irons by employment of diagonals. This would be easily applicable to the outside and inside of the foundation.

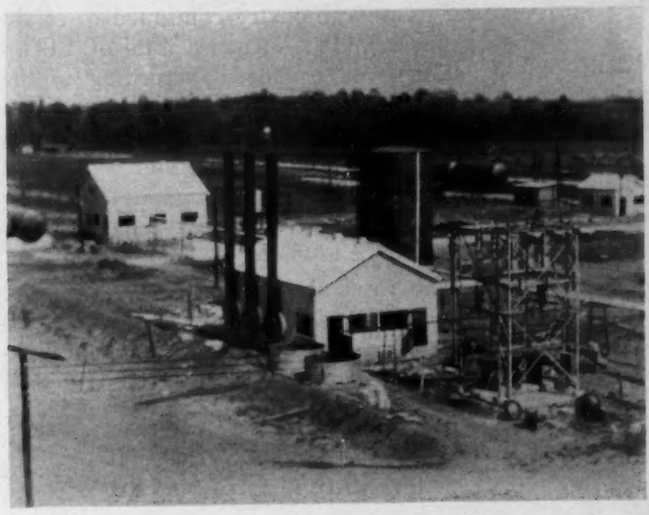
Dock facilities have not been built at the Houston plant of the Phillips Petroleum Company, and at present the docking facilities of Crown Cen-

tral Petroleum Company are being used. But equipment has been installed for loading oil, preparatory to the time when the company shall build its own terminal docks. For loading power, the plant has two Goulds centrifugal pumps directly connected to two 50-horsepower Wagner motors. These pumps have a capacity of 2000 gallons per minute each. They feed a 16-inch electric welded line running from the company's 50-acre plant site to the dock of the Crown Central Petroleum Company.

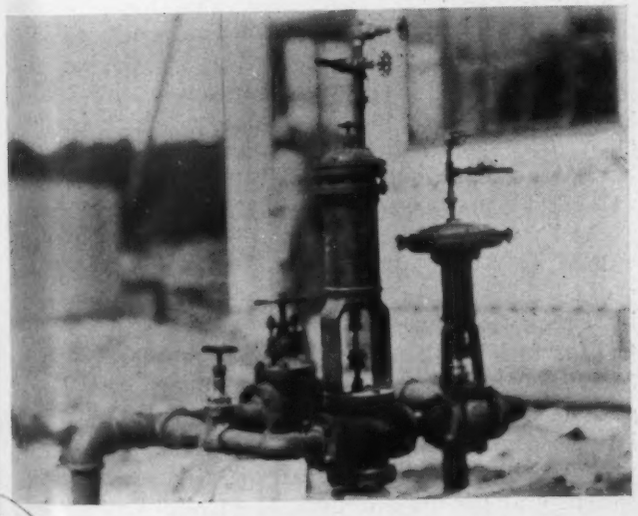
## VIEWS OF PHILLIPS PLANT ON HOUSTON CHANNEL



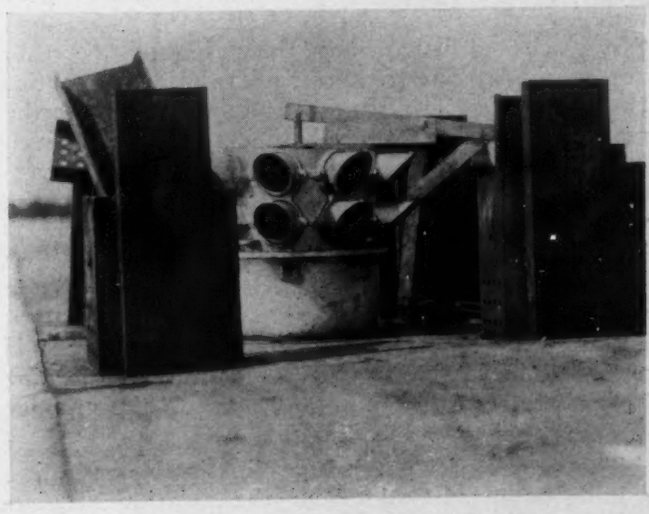
*Tulsa type fractionator and Pritchard cooling tower*



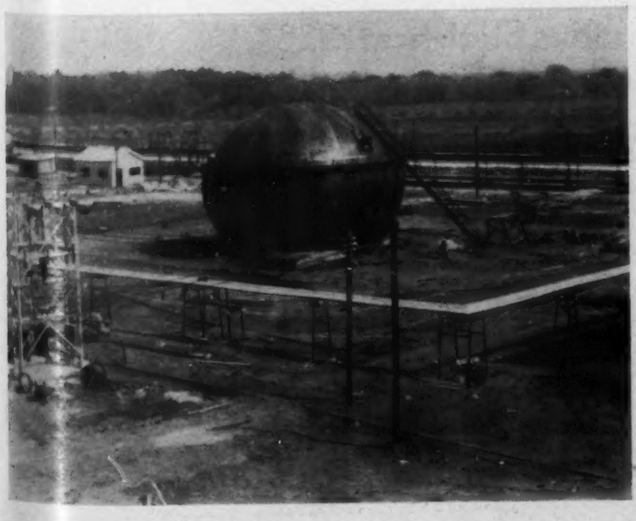
*Boiler plant and Transformer Tower*



*Valves and regulators controlling the automatic boiler fire snuffing arrangement*



*Wiggins Breather Roof Apparatus*



*Two of these Chicago Bridge & Iron Works spheroids are used in the Phillips plant*

*Illustrating method used to keep crawling tendencies of oil field boiler from crumbling a brick foundation*

# Natural Gasoline Industry Expansion Slowing Down

THE natural gasoline industry continued to establish new records in 1928, when a total of 1,814,034,000 gallons was produced, according to the United States Bureau of Mines. This represents an increase over 1927 of 11 per cent. as compared with an annual increase of 20 per cent. the preceding year and 21 per cent. in both 1926 and 1925, indicating a slowing down in expansion to a point close to the average for the petroleum industry as a whole.

During 1928, the total supply of natural gasoline aggregated 1,819,000,000 gallons, including 5,000,000 gallons drawn from storage. Of this total, 1,399,000,000 gallons, or 77 per cent was reported as blended at refineries; 107,000,000 gallons, or six per cent, was turned into pipe lines and run to stills; 27,000,000 gallons, or 1.5 per cent, was estimated to have been blended by jobbers, leaving 261,000,000 gallons, or 14 per cent, for losses and quantities not accounted for. Although natural gasoline manufacturers were favored with an increase in demand by refiners, they slackened little, if any, their attempts to create new markets. The trend of modern refinery practice has been to get away from blending, which with the recent growth of vapor-phase cracking has given natural gasoline manufacturers no chance for overconfidence. Although no data are available on the use of the lighter ends of natural gasoline for heating or in the chemical industry, it is possible that such consumption grew materially in 1928. It is also apparent that the practice of shipping natural gasoline in bulk by tankers to foreign countries is assuming increasing importance, as foreign gasoline buyers are resorting more and more to the practice of doing their own blending.

The demand for natural gasoline is also assuming a more important role from the aviation requirements of the United States; hence, manufacturers are assured of a growing market from this source in the future.

The trend toward the absorption method of producing natural gasoline was continued during 1928, when a total of 1,563,929,000 gallons, or 86 per cent of the total, was produced by this method. The number of compression plants continued to decline; only 446 were in operation in 1928 as compared with 490 in 1927. This decline, as in former years, was the result of the dismantling of small plants, principally in the Eastern States, which have proven uneconomic at prices prevailing over the past few years. The number of absorption plants increased from 599 in 1927 to 604 in 1928. Practically all of the new plants were in the Seminole area and in the Panhandle and North Central Texas. The number of charcoal plants declined from 30 to 28, but the total output from this source continued its steady annual increase.

During 1928, natural gasoline was produced in 15 states and 151 counties, as well as in Alaska. Los Angeles County, California was again the leading producer during 1928. This county, which includes such fields as Santa Fe Springs, Long Beach and Seal Beach, produced 350,878,000 gallons in 1928, valued at $30,612,000. Seminole County, Oklahoma, ranked second, with an output of 266,742,000 gallons, valued at $17,615,000. Osage County, Oklahoma, ranked third in the United States, followed in order by Creek County, Oklahoma, Orange and Ventura, California. Stocks of natural gasoline declined from 32,226,000 gallons on January 1, 1928 to 27,161,000 gallons on December 31. Oklahoma showed the largest decline in stocks. The following summary, prepared by the U. S. Bureau of Mines, presents the salient statistics of the natural gasoline industry for the year 1928:

## Summary of Natural Gasoline Statistics, 1928

| | Number of plants | Production (thousands of gal's) By compression | By absorption and combination | By charcoal | Total | Value at plants Thousands of dollars | Average per gallon (cents) | Estimated quantity of natural gas treated Millions of cubic ft. | Average-yield per M cubic ft. (gallons) | Stock at plants (Thousand of gal's) Jan. 1 | Dec. 31 | Natural gasoline turned into pipe lines Thousands of gallons |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alaska | 1 | ..... | 26 | ..... | 26 | 3 | 11.5 | 20 | 1.3 | ..... | 1 | 22 |
| Arkansas | 14 | 2,769 | 27,484 | 2,424 | 32,677 | 2,568 | 7.9 | 13,030 | 2.5 | 296 | 324 | ..... |
| California | 147 | 3,579 | 580,532 | ..... | 584,111 | 53,885 | 9.2 | 380,059 | 1.5 | 1,449 | 1,576 | 80,000 |
| Colorado | 2 | ..... | 1,909 | ..... | 1,909 | 136 | 7.1 | 3,498 | .5 | 34 | 12 | ..... |
| Illinois | 78 | 7,817 | ..... | ..... | 7,817 | 585 | 7.5 | 2,999 | 2.6 | 217 | 197 | 4 |
| Kansas | 25 | 6,872 | 29,893 | ..... | 36,765 | 2,444 | 6.6 | 33,091 | 1.1 | 723 | 981 | 5,050 |
| Kentucky | 12 | 1,383 | 4,973 | 911 | 7,267 | 575 | 7.9 | 25,801 | .3 | 122 | 119 | ..... |
| Louisiana | 49 | 8,226 | 45,881 | 915 | 55,022 | 3,434 | 6.2 | 129,513 | .4 | 898 | 1,190 | ..... |
| New Mex. | 1 | ..... | 1,506 | ..... | 1,506 | 107 | 7.1 | 731 | 2.1 | 48 | 147 | ..... |
| New York | 3 | 117 | 275 | ..... | 392 | 45 | 11.5 | 411 | 1.0 | 27 | 34 | ..... |
| Ohio | 35 | 700 | 10,671 | 1,803 | 13,174 | 1,146 | 8.7 | 49,572 | .3 | 750 | 193 | ..... |
| Okla. | 297 | 106,779 | 512,800 | 112 | 619,691 | 40,959 | 6.6 | 275,961 | 2.2 | 15,911 | 11,137 | 8,093 |
| Penn. | 131 | 5,026 | 10,752 | 793 | 16,571 | 1,570 | 9.5 | 49,542 | .3 | 1,100 | 802 | ..... |
| Texas | 156 | 40,441 | 282,850 | 1,225 | 324,516 | 22,492 | 6.9 | 309,769 | 1.0 | 8,815 | 8,387 | 13,361 |
| West Va. | 118 | 11,781 | 42,086 | 15,862 | 69,729 | 6,220 | 8.9 | 164,120 | .4 | 1,426 | 1,565 | ..... |
| Wyoming | 9 | 30,570 | 12,291 | ..... | 42,861 | 2,775 | 6.5 | 35,317 | 1.2 | 410 | 496 | 86 |
| Total 1928 | 1,078 | 226,060 | 1,563,929 | 24,045 | 1,814,034 | 138,944 | 7.7 | 1,473,434 | 1.2 | 32,226 | 27,161 | 106,616 |
| Total 1927 | 1,119 | 241,799 | 1,377,122 | 22,223 | 1,641,144 | 118,688 | 7.2 | 1,341,248 | 1.2 | 19,445 | 32,226 | 152,679 |

# Synthetic Industry Based on Petroleum

THE Industrial Bulletin of Arthur D. Little, Incorporated, in a recent issue has much to say about the coming synthetic industry based on petroleum. Such an industry, which as yet can hardly be said to have been born, is to come as the fruits of research now under way. However, it is thought that a synthetic industry based on petroleum can not be considered as a means of utilizing by-products or as a side-issue in petroleum refining, but must stand upon its own merits much as the dyestuff industry does. The production of synthetic products, organic chemicals, from petroleum commands enormous supplies of raw materials and possesses ample outlets for such products. The synthetic processes present many difficulties, yet there are a few which are at present both technically and commercially successful.

Some enthusiastic prophets have forcast an industry destined to surpass that industry based upon the processing of coal tar in value and utility of products. Industrial Bulletin asks the questions, "It this an accurate prediction? Are significant new uses about to be made of petroleum in addition to its uses as fuels and lubricants? Are important new industries about to come into existence, based on petroleum? In giving its answer in its own way to these questions the Bulletin brings out some valuable information and interestingly summarizes the scope of the synthetic industrial commercial processes down to date. A digest of the article follows:

"We need first to consider that synthetic products must nearly always compete with similar or identical substances of natural origin. In spite of the triumphs of chemistry in the synthesis of solvents, dyestuffs and medicinals, we must admit that the outstanding products of plant and animal life—the fats, proteins, sugars, starches and celluloses—have not yet been produced synthetically, save occasionally by purely laboratory methods. Products may indeed be synthesized from petroleum hydrocarbons that compete with natural alcohols, fatty acids or glycerine, yet the natural substances are also readily obtained from starches, sugars and fats by chemical means or by the action of microorganisms. Synthetic products from coal, on the other hand, are derived from the aromatic group of hydrocarbons, which are but minor products of plants and animals.

"The synthesis of chemical products from coal has another important advantage in being chiefly based on but four substances (benzene, toluene, naphthalene and anthracene), though three others (xylol, phenol and cresol) are of considerable importance. All of these can be easily separated from tar and from each other. The number of petroleum hydrocarbons, on the contrary, is very large. Their mixtures are so complex that it is almost impossible to separate out any component in a pure form if its boiling point happens to be above 100° F. Anthracene, the most difficult of commercial coal tar hydrocarbons to purify, is actually more easily purified than any of the petroleum hydrocarbons that are liquid above 100° F. This is a serious handicap for petroleum as a raw material, since chemical products produced from mixed or incompletely purified raw materials are always more complex than the raw materials themselves.

"By noting the difficulties of developing a synthetic industry from petroleum, we are anxious not to give the impression that such a development is hopeless. Processes are known for obtaining alcohols from the lightest petroleum fractions which compete with fermentation alcohol for all uses except the use as a beverage. The pentane fraction of low boiling liquid petroleum hydrocarbons (boiling range about 90-100° F.) is being used on a commercial scale at present to produce solvents for the lacquer industry in competition with the butyl alcohol and fusel oil of fermentation. The corresponding butylene and amylene fractions of cracked petroleum gases have been converted to alcohol, also competing with fermentation butyl alcohol and fusel oil. This process is not being operated on a commercial scale, although its technical value has been fully demonstrated.

"Propylene, one of the chief gaseous products obtained in cracking petroleum, has been converted to isopropyl alcohol, and there are a number of plants for this process. Isopropyl alcohol competes as a solvent with fermentation ethyl alcohol, and has the advantage that it is useless for beverage purposes, and therefore pays no tax and requires no denaturing for industrial use. It may be easily oxidized to acetone, which competes with acetone produced by fermentation.

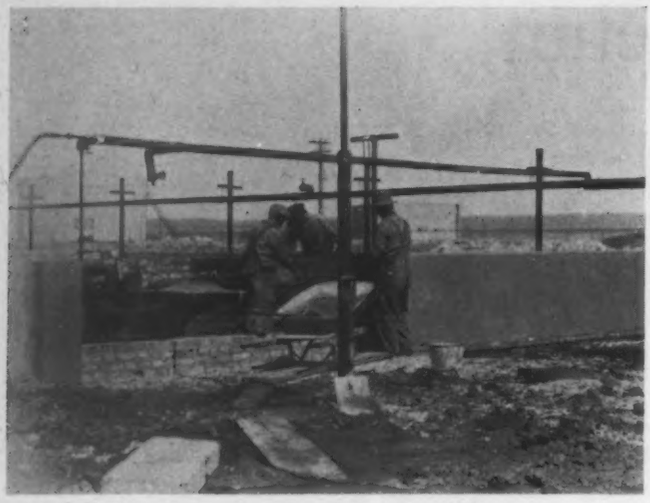
"Another important component of the mixture of gases produced in the cracking of petroleum is ethylene. This can be converted into ethyl alcohol or ether. By another process, ethylene may be converted into glycol, which itself competes with glycerine, and whose chemical derivatives are lacquer solvents, competing with the esters of fermentation butyl alcohol and fusel oil. The glycol industry is today well established on a commercial scale.

"The potential magnitude of these synthetic industries based on petroleum may be indicated by the production and value of the materials with which they compete. In 1928, 48,000,000 pounds of fermentation butyl alcohol were produced, valued at $9,000,000. There is sufficient butylene, amylene and pentane in petroleum gases to replace this with synthetic products. The demand for acetone is estimated at 65,000,000 pounds a year. Fermentation ethyl alcohol produced in the United States in 1928 was 99,600,000 gallons, worth $47,800,000. Glycerine from fats in 1925 was 47,000 tons, valued at $16,991,000. There is sufficient ethylene and propylene in refinery gases to replace a large portion of these by similar or identical synthetic ones. These figures show plainly the enormous potential values of synthetic products from petroleum."

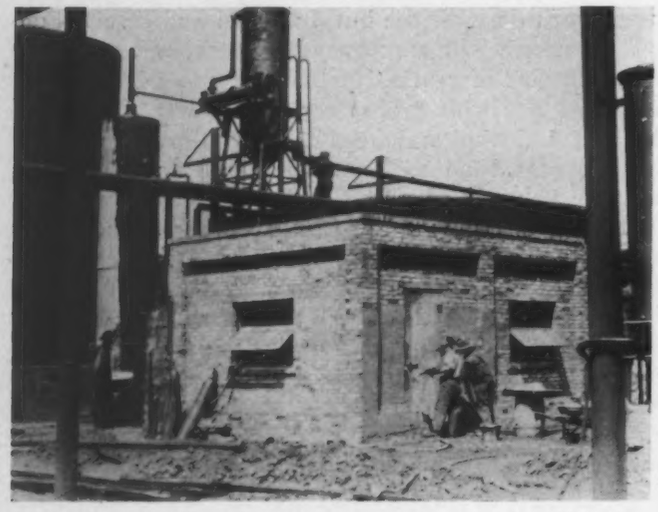
# USES FOR SALVAGED FIRE BRICK IN

CHANGING refining methods and replacement of obsolete equipment oftimes leaves the refinery management with an excess of salvaged materials which can be built into usable equipment. We present here a series of pictures showing what was done with a quantity of reclaimed firebrick that was on hand after the replacement of some old stills.

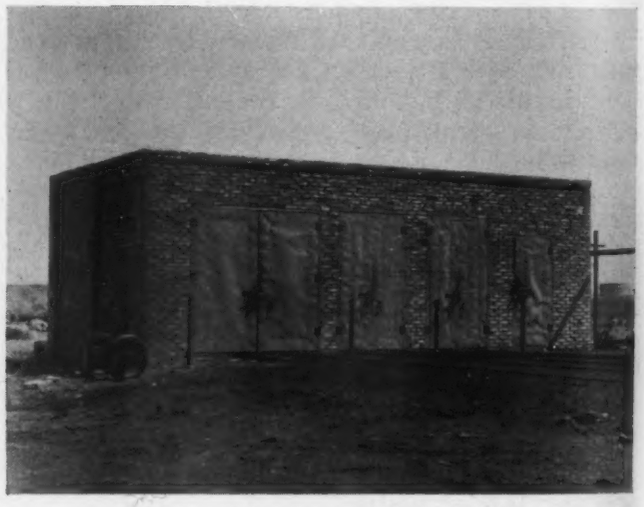
The brick was cleaned during slack periods by the regularly maintained refinery labor crew, and the brickmasonry, carpentry, plastering and finishing work of the new construction was done during times when the refinery maintenance crew was caught up on repair work. In other words, no money for labor for construction or unusual expense was paid out as cash as the men doing the work had to be retained on the payroll for emergency repair and regular maintenance work. By careful accounting of labor distribution the investment account for refinery equipment could be fairly charged with a part of the cost of labor as the value of the refinery property was enhanced. The refinery superintendent was justified in crediting his operating expense with a fair amount of the labor and debiting new construction or investment accounts.



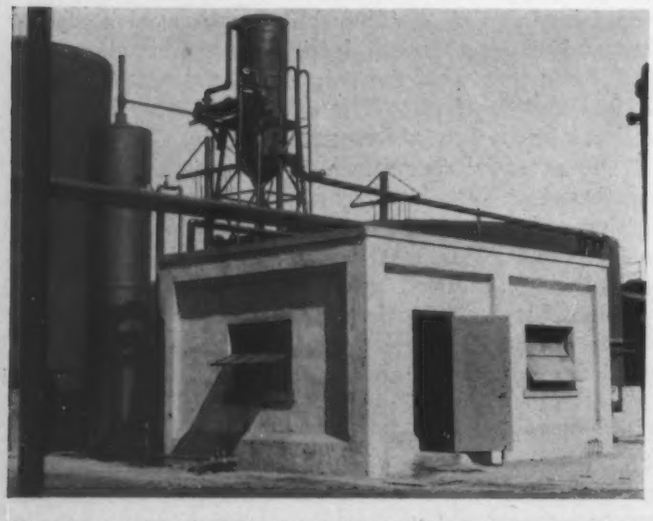
*A crew of three men was usually the maximum; one skilled mechanic and two unskilled helpers*



*Pressure distillate stabilizing pump house, built of salvaged fire brick, nearing completion*



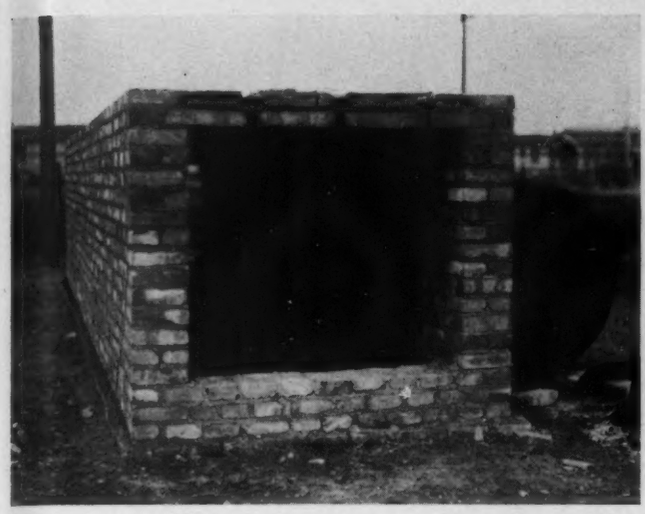
*The locomotives used on the plant railway for hauling coke from cracking stills, are housed in this terminal built of old fire brick*



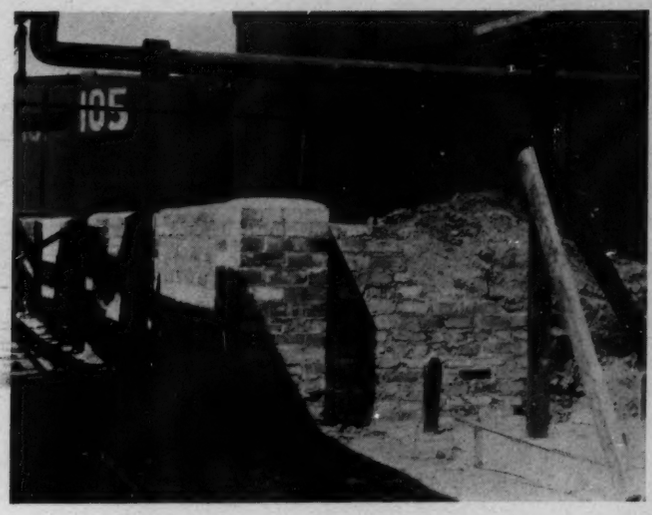
*The above pump house after being stuccoed, and presenting a commendable plant addition without unusual cash expenditure for labor*

*At a convenient location near the cracking plant was built this combination tool house and emergency fire station. The construction is of old fire brick plastered on the outside*

# CONSTRUCTION AROUND THE PLANT



*This out-door furnace was built for burning out tar lines from the cracking stills. It is built of old furnace fire brick, has gas lines within for fuel, and is conveniently located near the cracking plant*

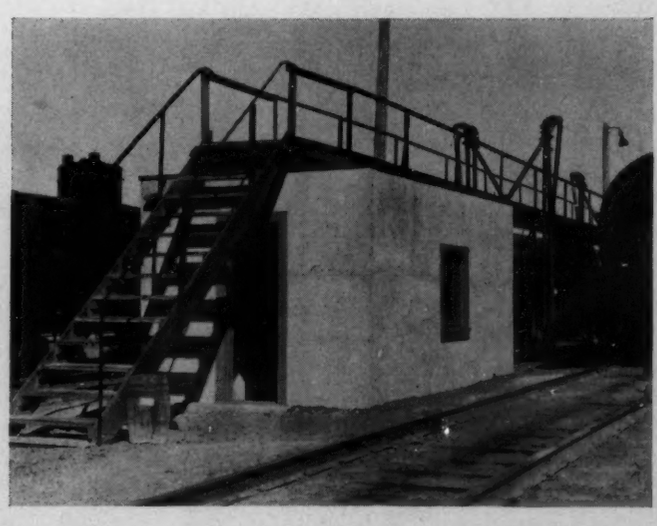



*The fire walls are built high and thick, with dirt fill sloping from the top of the inside wall toward the tanks*

*Old fire brick formed the rigid skeleton of this sump where space and sump-control were important factors*

*Wooden steps over the brick firewalls were built by the carpenter force during slack days*

*These brick firewalls proved to be easily maintained, afford good protection and save space in congested districts of run-down tanks*



*A rickety old wooden structure housing loading-rack manifold equipment was replaced by this fireproof structure built of old fire brick and plastered*

PROCEEDINGS OF WESTERN PETROLEUM REFINERS' ASSOCIATION

# Refiners Continue Study of Two Problems

TWO subjects, which came before the Manufacturers' Committee of the Western Petroleum Refiners Association, in session at Tulsa, October 28 and 29, were carried over for further consideration.

One, "Importance of Correct Temperatures in Tank Car Loading," presented by H. T. Bennett of the Mid-Continent Petroleum Corporation, resulted in the passing of a motion to the effect that the subject be presented to the A. S. T. M. as well as instrument manufacturers, with further study by the Manufacturers' Committee, and also with the provision that whatever method is finally approved be made available to jobbers, so they can use the method in unloading refined products.

Mr. Bennett offered results of experiments, which disclosed inaccuracies when using present methods of taking tank car temperatures. Both methods and some of the instruments now used were blamed for some of the inaccuracies. Especial stress was placed on the fact that temperatures of heavy oils are seldom correct. The cup type thermometer was classed as unsatisfactory, because the cup fills at the top of the material, which has a higher temperature than either the middle or the bottom of the material.

One experiment used by Mr. Bennett was on a tank car filled with water, which was allowed to stand several days. Temperature was taken both with and without the cup. Time of taking the readings was varied, one after two minutes of immersion, the other after 15 minutes immersion. Variations in temperatures were from 90.9° to 107.2°.

After C. E. Votrain of Barnsdall Refineries had presented his discussion of the subject, "Refinery Cost Accounting," a motion was passed that another committee be named to continue the study of this subject and that it be taken up by committees of other organizations of the petroleum industry, especially the accounting divisions of refining concerns and the committee working on the accounting subject for the American Petroleum Institute.

When the Manufacturers' Committee met in St. Louis last spring in connection with the annual association meeting, the subject of cost accounting was brought up by L. M. Crawford, chairman of the committee. The discussion led to the naming of a committee with F. E. Holsten, vice president of Barnsdall Refineries, as chairman. This committee then went to work on the subject and the paper presented in Tulsa was the result.

There was difference of opinion concerning certain parts of the recommendations made in the paper Mr. Votrain read. The proper method of charging off obsolete equipment was one of these. Some favored a reserve for obsolete equipment, similar to that for depreciation of equipment, which serves its full life. Others were of the opinion that obsolete equipment should be charged against the general reserve.

The consensus of opinion, however, was that whatever method is adopted for the whole matter of refinery cost accounting should be understood for the whole industry, in order to assure that each refiner could calculate his costs on gasoline as all other refiners do. It was with this purpose in mind that the subject was continued.

Another committee will be named to continue study of the subject within the Western Petroleum Refiners Association, as well as to take the subject before other organizations which are in position to lend assistance on the question.

The meeting opened in the Mayo Hotel, October 28, and the program that morning was devoted to a discussion of "Vacuum Distillation," by Earl Petty of the Smith Engineering Company of Tulsa. Then Col. George A. Burrell offered a paper on "Pressure Distillate Stabilization." Mr. Bennett then offered the results of his experiments in temperature readings for tank cars.

Each paper was followed by lengthy discussion.

The afternoon of the first day was given over to a visit of refining plants in West Tulsa. Plants of the Mid-Continent Petroleum Corporation, The Texas Company and the Producers & Refiners Corporation, were visited.

The program the second day was as follows:

"Vapor Phase Cracking," C. R. Wagner, Pure Oil Company.

"Refinery Cost Accounting," C. E. Votrain, Barnsdall Refineries.

"Control of Refinery Operations with Instruments," F. M. Poole, Brown Instrument Company.

"Analysis of Natural and Refined Gases," Dr. W. J. Podbielniak.

"Determination of Gum in Gasoline," M. H. Nolan and Peter Vilkas, Producers & Refiners Corporation.

PROCEEDINGS OF WESTERN PETROLEUM REFINERS' ASSOCIATION

# Degasification, Fractionation and Storage of Pressure Distillate

By G. A. BURRELL and R. P. MASE
*Burrell-Mace Engineering Company, Pittsburgh, Penn.*

PRESSURE distillate as it leaves the receiver of a cracking unit is more or less charged with gas, depending upon the nature and degree of cracking and the pressure and temperature under which the separation of gas from the pressure distillate takes place. Upon release of pressure, as the pressure distillate leaves the receiving tank of the cracking unit, and in subsequent storage, treating, rerunning, etc., the gas is released and escapes, taking with it appreciable quantities of gasoline which are thus lost.

In some cracking systems pressure distillate is discharged from the rundown tanks to untreated storage and then pumped through a continuous treater or to a batch agitator and thence to treated storage. From the treated storage it is pumped to a rerun still, then from the rundown tanks of same to the sweetening unit and from there to finished storage. This is done directly in the case of a continuous treater, but if a batch agitator is used for sweetening the process is lengthened and more handling is required. Finally the finished gasoline is pumped to the loading rack and tank cars.

All the while losses of gasoline are occurring, depending upon the amount of handling, the atmospheric temperature, and the extent to which expedients are employed to minimize losses, such as type of tankage employed, use of a vapor recovery plant, and degree to which various units in the refinery are hooked up to the gasoline recovery plant. These losses may range up to four per cent of the pressure distillate handled.

A further disadvantage of handling pressure distillate charged with gas lies in the difficulty of pumping it in hot weather.

Briefly it can be stated that degasification, fractionation and pressure storage of light fractions will perform a triple function, as follows:

(a) Degasify the pressure distillate (including propane removal).

(b) Fractionate a light overhead cut from the pressure distillate that does not need acid treatment. This fractionation raises the boiling point of heavy cut so evaporation losses are greatly reduced.

(c) Hold the light cut under pressure storage so that light gasoline fractions will not be lost during this storage.

Enlarging a bit on the first of the foregoing functions the benefit of fixed gas removal is quite evident in its broad aspects. The benefit from complete removal of all propane, the heaviest of the true fixed gases, is now fully realized since for each per cent of propane excluded from finished gasoline, three and a half per cent of butane may be added, at the same time retaining the same vapor pressure of finished product. This follows from a consideration of the relative vapor pressures of these two hydrocarbons.

For those refineries that do not have vapor recovery plants, but want only pressure distillate degasification and fractionation, a different procedure is adopted than where a vapor recovery plant will treat vapors from these units.

There will be first discussed a degasification and fractionation unit in combination with a vapor recovery plant. In degasifying pressure distillate, gas is taken off the receiver, say at 150 pounds and sent to a vapor recovery plant. This gas will contain up to 1.0 gallon of gasoline per 1000 cubic feet of gas. The pressure distillate is put into a degasifying column. This column operates at about 30 pounds, the pressure distillate being put into the column over the top plate. A mist extracting plate or unit should be provided above the top contact plate. With some pressure stills expanding the distillate from high pressure to a lower one (150 pounds down to 30 pounds) in the column, cools it and furnishes lowered temperature for the top of the column. Heat must be furnished for the base of the column, and this is provided by a closed steam bundle, preferably using exhaust steam from the hot oil pumps. The gas passing overhead is brought to vapor pressure-partial pressure equilibrium with cool pressure distillate at 30 pounds pressure. The gasoline content of this gas is, therefore, comparable to that of the gas ordinarily leaving a 30 pounds separator.

This was flows through the vapor recovery plant without being compressed.

Bottoms from the column (degasified pressure distillate) may be cooled and sent to storage. The hot bottoms, however, are preferably flashed into a second column at low pressure so as to take overhead a fraction of same (5 to 30 per cent) that does not need acid treating. Color, gum and odorous compounds more or less concentrate themselves in the heavy fractions of a distillate so that frequently a cut can be made ond only the heavy portion of the distillate be acid treated. By operating this second column at low pressure, part of the sensible heat of the liquid leaving the reboiler of the first column is used to evaporate the light cut. Additional heat (closed steam) may be needed for the base of this second column if a considerable fraction of the pressure distillate is sent overhead. A condenser of ample surface is provided for condensing the over-

# PROCEEDINGS OF WESTERN PETROLEUM REFINERS' ASSOCIATION

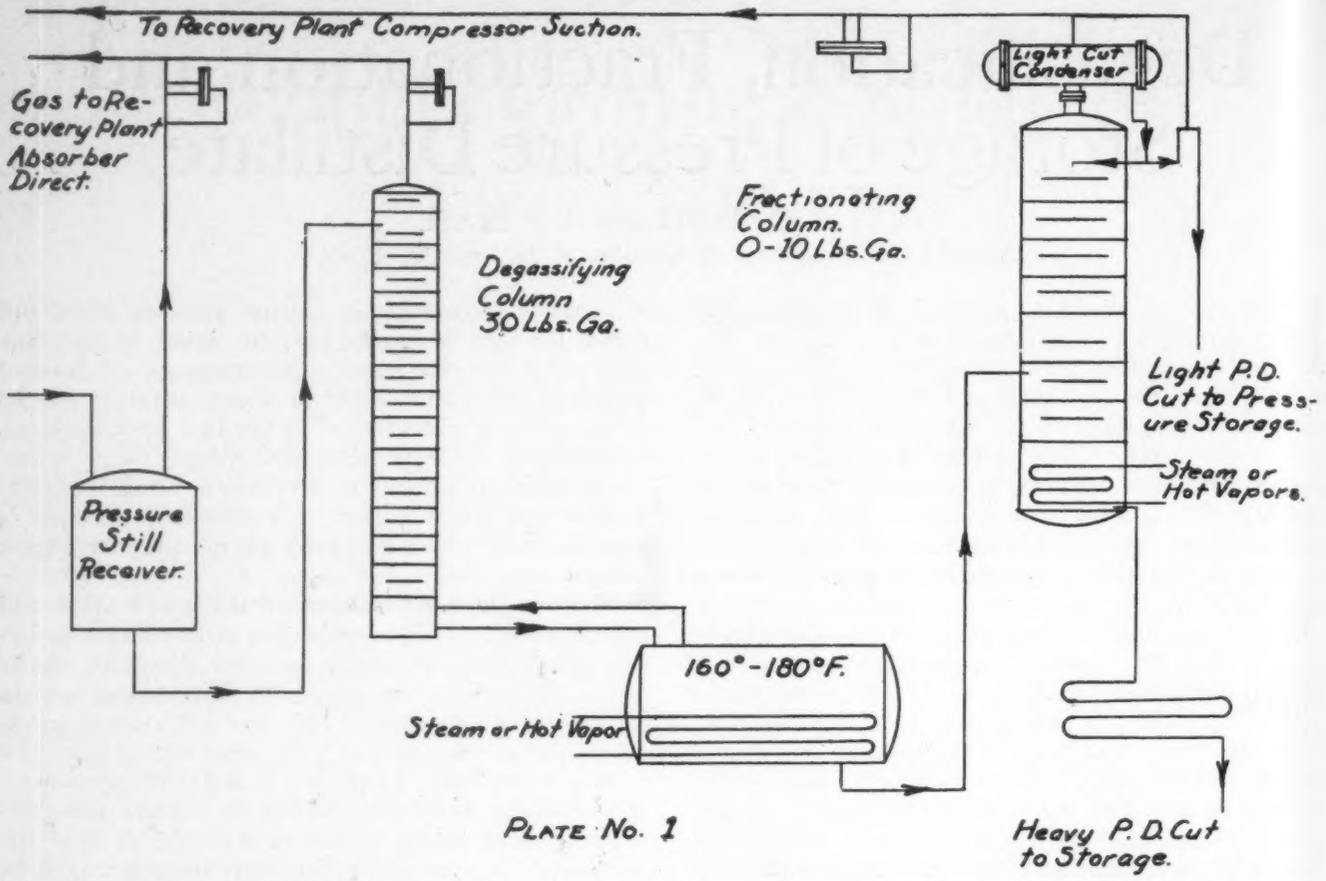

To Recovery Plant Compressor Suction.
Gas to Recovery Plant Absorber Direct.
Light Cut Condenser
Fractionating Column. 0-10 Lbs. Ga.
Degassifying Column 30 Lbs. Ga.
Light P.D. Cut to Pressure Storage.
Steam or Hot Vapors.
Pressure Still Receiver.
160°-180°F.
Steam or Hot Vapor
Heavy P.D. Cut to Storage.

PLATE No. 1

head cut of the second column. Part of the condensate thus formed is returned to the top plate as reflux, while the main stream is pumped to pressure storage. On its way it should be sweetened in a small continuous treater.

Preferably the light cut should be reunited with the heavy cut just prior to shipment. The blending can be done in the same manner as is ordinarily done when gasoline is blended with absorption gasoline.

The heavy cut from base of second column is cooled and sent to a run tank and is handled thereafter just as pressure distillate is now handled.

A diagram for a low pressure stabilizing-fractionating unit is shown at Figure 1.

Since the function and operation of the unit is largely one of two stage fractionation, i.e., of stripping gas from a liquid in the first column and of removing light pressure distillate from the heavy pressure distillate in the second one, ordinary principles of rectification have to be followed. Enough heat must be put into the base of the column to drive overhead the light fraction. The column must be of sufficient diameter to provide the necessary capacity and there must be enough plates for separation of the fractions. The necessary amount of reflux must be furnished the column, temperatures must be maintained as uniformly as possible; flow into the column must be constant, and velocities must not be too high. These are requirements of all columns, no matter what substance is being rectified.

Moderate heating is required for the base of the degasifying column (the 30 pound one). The temperature must be such as to drive out the gas at the operating pressure. The temperature ordinarily need not be higher than 180° for degasification at 30 pounds pressure distillate enters the column at about 60°. Hence the temperature must be raised 180°—60°—120°. If one assumes 1000 barrels of pressure distillate per day this is the equivalent to 11,000 pounds per hour. Hence there is needed 11,000x.50x 120=660,000 B.T.U. per hour for heating above. In addition, we must evaporate approximately 10 per cent of the liquid in order to drive out the gas.

.10x11,000x125=137,500 B.T.U. per hour for this purpose or a total of substantially 800,000 B.T.U. per hour. To this we must add about 10 per cent for heat loss, giving a total of nearly 900,000 B.T.U. per hour. If low pressure steam is utilized for heating this is equivalent to 27 boiler horsepower.

Most hot oil high pressure pumps used with cracking plants are direct steam driven and often this steam is wasted. As it leaves the pumps it contains 95 per cent of the heat of the steam. The steam required for the hot oil pumps of some cracking units is approximately 125 pounds per barrel of pressure distillate. From this it becomes apparent that for each 1000 barrels of pressure distillate per day produced there will be available on the order of 150 boiler horsepower of low pressure steam, while only 27 is needed for the pressure distillate reboiler.

The temperature at the top of the column due to the expansion of the pressure distillate into it will be of the order of 60°. The gasoline escaping over-

# PROCEEDINGS OF WESTERN PETROLEUM REFINERS' ASSOCIATION

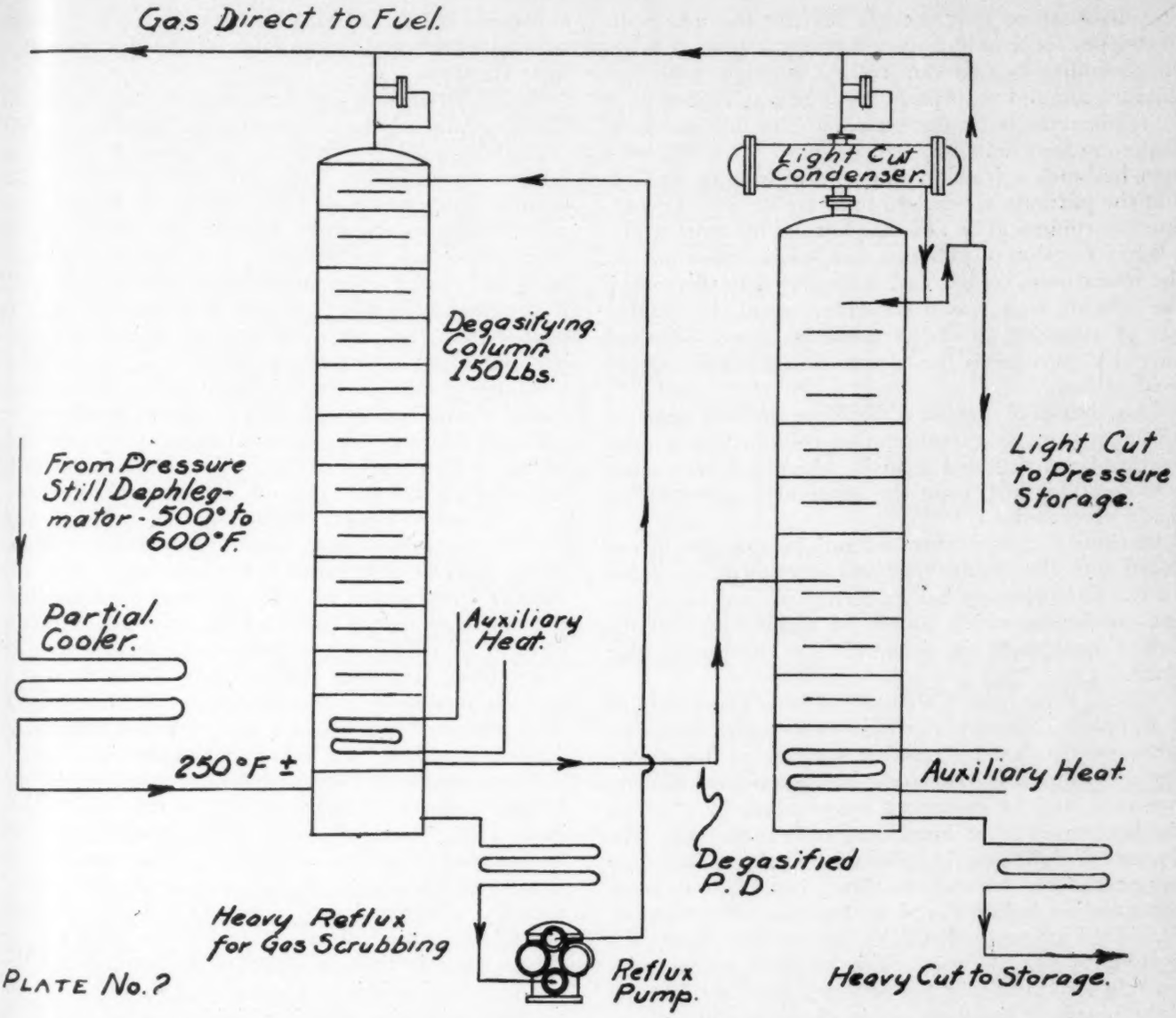



PLATE No. 2

head with the gas is only that necessary to saturate the gas in contact with the pressure distillate at the temperature and pressure (30 pounds and 60°) of the latter. This will be of the order of 1½ to 2½ gallons per 1000 cubic feet and goes to the gasoline recovery plant to be recovered.

The stabilized pressure distillate now enters the second or fractionating column at a temperature a little less than 180°. Enough heat has to be put into it to fractionate overhead up to say 30 per cent of the pressure distillate. If only a few per cent of the pressure distillate is taken overhead, the sensible heat already in the pressure distillate (180°), will be enough to drive overhead the desired fractions.

From some very sour pressure distillates it is possible that no tops can be taken off for the whole pressure distillate may need acid treatment. It is a fact, however, that the gum, color and odor forming constituents, concentrate themselves in the heavier fractions, so much so that a top cut can usually be removed that only needs a doctor wash. This can easily be determined in the laboratory.

If 30 per cent of the pressure distillate can be removed in the column, a considerable part of the pressure distillate must be driven from the base of the column. The top temperature can be controlled by thermostatically returning part of overhead condensate or by a partial condenser cooled by charging stock or water.

The foregoing arrangement of stabilizer and fractionating column, and accessories can be modified if desired, so as to utilize heat of the hot pressure distillate for column heating after the pressure distillate leaves the dephlegmator of the cracking unit, and before it is cooled. This waste heat can be utilized for bottom heat of the columns, instead of the waste heat from the exhaust steam of the hot oil pumps.

There remains to be considered a degasifying — fractionating — pressure-storage unit for a refinery that does not have a vapor recovery unit, or may not care to install one. In this case, the stabilization must be conducted at as high a pressure, and low a temperature as possible, at the same time prefarably contacting the overhead gas with heavy pres-

## PROCEEDINGS OF WESTERN PETROLEUM REFINERS' ASSOCIATION

sure distillate so that the gas leaving the unit will be stripped as cleanly as possible of gasoline. Under these conditions, one can resort to high pressure stabilization and absorption, as shown at Figure 2.

Stabilization is conducted under the full pressure of the cracking unit, say 175 pounds. The first column becomes a fractionating and absorbing one, in that the partially condensed pressure distillate is put into the column at or near the bottom of same, while a heavy fraction of pressure distillate is taken out of the tower base, cooled, and recirculated to the top of the column, to act as a scrubbing agent, to rid the gas of virtually all the gasoline it carries, so that only dry gas leaves the top of the stabilizer, to be used as fuel.

The stabilized pressure distillate is then sent at lower pressure to a fractionating column, and a light overhead cut removed from it, which does not need acid treating, just as in the other arrangements already discussed.

Obviously, many minor variations may be introduced into the degasifying and fractionating equipment. Each refinery has its own particular problems and conditions which should be studied thoroughly before equipment is designed for that particular plant.

Wilde, Brian and Coleman[1] of the Humble Oil & Refining Company, decrease evaporation losses of pressure distillate by passing same from the cracking unit into a fractionating column at 120 pounds pressure, and an operating temperature of 375°, at the bottom of the column, and 150° at the top. An amount of light gasoline plus gas equal to about four per cent of the pressure distillate, is taken overhead, the gasoline being stored at 100 pounds pressure. Stabilized pressure distillate is removed from the bottom of the column. This method serves adequately for stabilizing the pressure distillate, but the light pressure distillate cut is charged with gas at 100 pounds and is exceedingly wild, so that such handling of it as is necessary entails loss. Further, expensive 100 pound tanks are needed. The present authors prefer to remove more of the gas from this light fraction.

Wilde, Brian and Coleman also stabilize crude oil charging stock before it enters the toppers or other crude stills. This is done by fractionating the crude oil in a tower, under a pressure of 50 pounds, with a bottom temperature of 280°, and a top temperature of 172°. In some cases a light cut amounting to four per cent of the charging stock is removed overhead and stored under a pressure of 28 pounds until it is mixed with other gasoline and shipped. Gas is vented from the accumulator tank of the fractionating unit to a vapor recovery plant.

At one refinery in the Mid-Continent field degasification (stabilization) of the pressure distillate or pressure storage of a portion of same is not attempted but a 30 per cent cut of the pressure distillate is removed and not acid treated. This is done by means of a secondary tower attached to the cracking unit in that the pressure distillate is condensed as a whole in the receiver of the unit in the customary way, and then heat exchanged with hot pressure distillate from the dephlegmator of the cracking unit, and introduced into a column. A steam bundle in the base of the column furnishes the necessary heat, so that a top cut is driven overhead and condensed and not acid treated. Bottoms are thus stabilized and acid treated, but there is a heavy loss of the light cut.

At another refinery the pressure distillate is stabilized under a pressure of 300 pounds per square inch. This means that the pressure distillate must be pumped from the cracking system pressure of about 150-175 pounds, to the column pressure of 300 pounds. Overhead gas does not go to recovery plant but is used direct as fuel. The objection to this system is that in order to accomplish the desired separation it is not necessary to go to this high pressure with the resulting high pumping and heating cost.

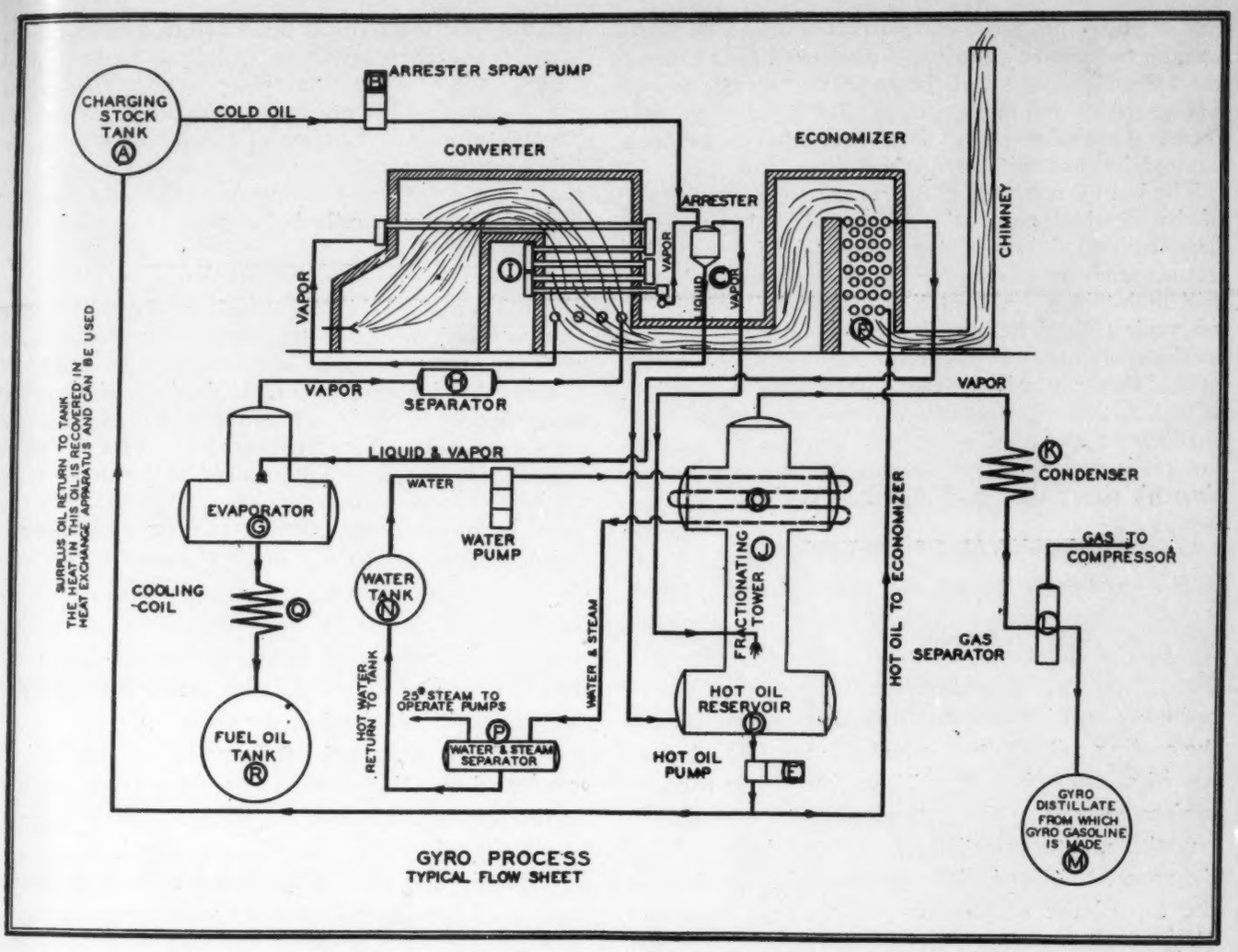
[1]Oil & Gas Jour., Oct. 3, 1929, p. 222.

# Vapor Phase Cracking

By C. R. WAGNER
*Assistant Chief Chemist, The Pure Oil Company*

INTEREST in vapor phase cracking is increasing rapidly in the industry because of the character of the products produced. The motor fuel fractions offer a fair substitute for motor benzol for blending with ordinary gasoline in the making of premium anti-knock fuels. For example, a refiner operating on an average crude containing 30 per cent gasoline can market his entire product as a premium fuel, if he charges his topped crude to a vapor phase cracking plant. For each 1000 barrels of crude handled he has added to his plant revenues at least $504, half of which is collected on what would otherwise be ordinary motor gasoline.

The gases from a vapor phase cracking unit offer unusual opportunities to the refiner. Already these gases are being used in large quantities for the manufacture of glycol, acetone, alcohols and for gas enrichment. The dry gas has a fuel value of about 1700 B.t.u. per cubic foot, which makes it a particularly valuable product for enrichment purposes. Due to its high olefine content it acts also as a carrier




**GYRO PROCESS**
TYPICAL FLOW SHEET

for naphthalene and thus assists in one of the most serious problems confronting the gas industry.

With little additional cost it would be possible to separate fairly pure ethylene, propylene or butylene from the gas. The commercial possibilities in marketing these products are enormous. It seems probable, however, that the most profitable utilization of this gas lies in its conversion into motor fuel. It has been discovered that over half of the dry gas produced can be converted into motor fuel distillate of even higher antiknock properties than the original product of the vapor phase cracking operation. This distillate is very rich in compounds boiling between 150° and 300° F., lends itself readily to treatment and yields a stable motor fuel. It appears to have particularly valuable possibilities in the field of aviation fuels.

## GYRO PROCESS

Among the first to offer to the public a vapor phase cracking process which could compete with liquid phase cracking methods was the Gyro Process Company. By reference to the accompanying flow sheet the method of operation and the salient features of the process become evident. The highest pressure used in the system is about 100 pounds gage and this is on the cold oil spray to the arrester. The evaporator carries the highest vapor pressure of the system and this ordinarily runs between 10 and 20 pounds gage. The converter, to which are localized all temperatures above 750° degrees F. used throughout the entire apparatus, can contain not more than 10 gallons of oil as vapor at any one instant.

Owing to the method used in delivering vapors to the converter it is possible to handle any grade of oil as charging stock. Fractions boiling within the range of the motor fuel desired are eliminated at once and by control of the oil line temperature and rate of steam flow into the evaporator as much or as little of the charging stock as desired may be eliminated as fuel oil. Charging stock from the tank (A) is delivered by means of the pump (B) to the arrester (C) spray nozzles where the vapors leaving the converter (I) are reduced in temperature from 1100° F. to 600° F. The liquid from the arrester which consists of residuum from the charging stock plus any condensed material from the converter passes by gravity to the hot oil reservoir (D). The vapors from the arrester, which consist of vaporized portions of the charging stock plus uncondensed products of the converter, pass to the fractionating tower (J). This fractionating tower is so designed that the distillate which is condensed from the vapors leaving the top of it will have a boiling range commensurate with the motor fuel desired. This boiling range is controlled by means of the refluxer (O) which may be arranged, as shown on the flow sheet, for the production of low pressure steam. The quan-

tity of steam produced in this manner is more than enough to operate all of the pumps used in the process and to supply all of the required process steam. The gas from the gas separator (L) is led to a compressor for the recovery of its liquefiable motor fuel content by any suitable method.

The hot oil reservoir (D) acts as a collector for all of the oil which enters the system which has not yet been converted into motor fuel or fixed gas. The hot oil pump (E) is controlled as to speed so that it will maintain a constant liquid level in the hot oil reservoir (D). The quantity of this hot oil delivered to the economizer (F) is regulated by an automatic rate of flow controller. This rate of flow is so maintained that the converter is constantly supplied with the correct quantity of vapor. The balance of this hot oil is returned to the charging stock tank (A) through either heat exchangers or coolers.

## REMOVAL OF RESIDUUM

The portion of the hot oil which passes through the economizer leaves the economizer (F) at a temperature of about 700 degrees Fahrenheit and enters the evaporator (G). Here the fuel oil drops out as residuum and is removed from the system through the cooling coil (Q) to the fuel oil tank (R). Superheated steam is introduced into the system through perforated coils in the bottom of this evaporator in quantity not to exceed three per cent by weight of the vapors produced. The vapors and steam leaving the top of the evaporator pass through separator (H) which removes particles of entrained liquid. From the separator the vapors pass through a series of pre-heater or drying tubes in the bottom part of the converter (I) to the inlet of the converter. In these drying tubes the vapors are given about 30° to 50°F. superheat which suffices to remove the white fog that always accompanies any stream of saturated gas oil vapor. These fog particles are in reality tiny drops of liquid oil and unless removed cause some difficulty in the operation of the converter. In passing through the converter the temperature of the vapors is increased to approximately 1100°F. and the conversion to lighter hydrocarbons occurs at this point. In this converter the vapors are distributed by means of the inlet header and passed through a number of tubes in parallel, the tubes containing catalytic cores. From the outlet of the converter (I) the vapors pass into the arrester (C) which was described above.

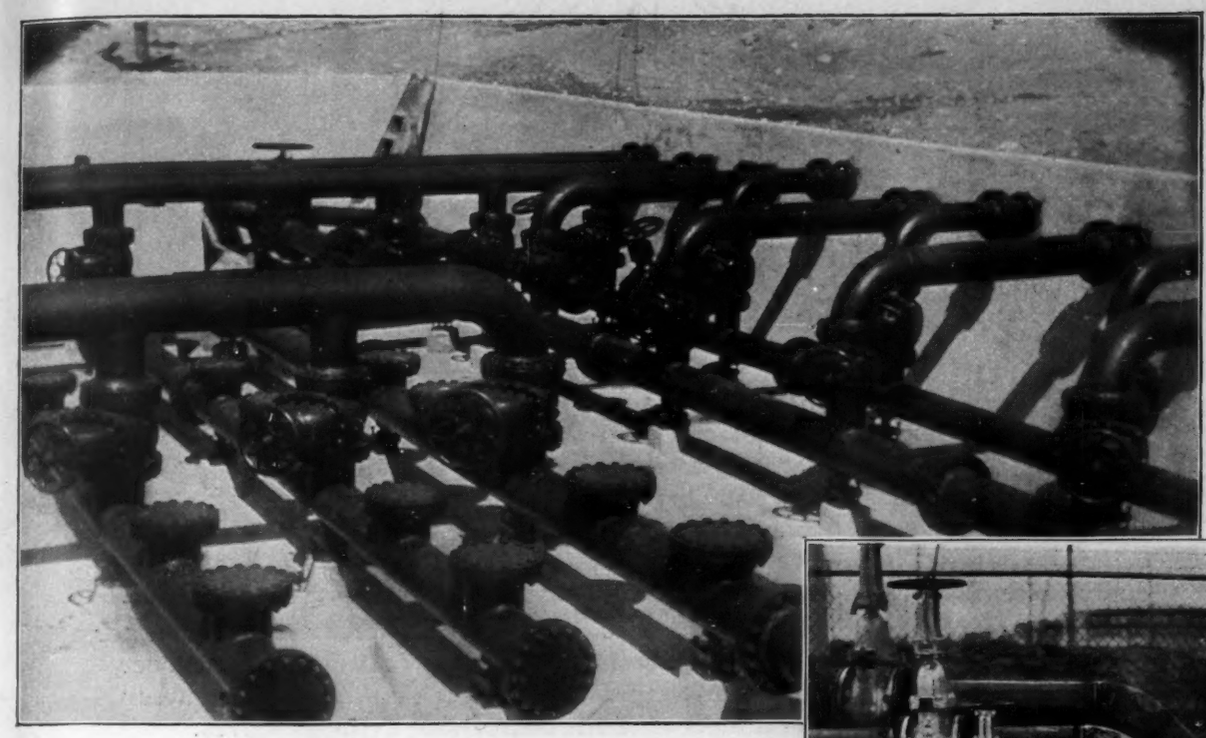
## EXPERIMENTAL UNIT

In developing this process it was necessary to carry on considerable fundamental research work and for this purpose a small unit was developed which would handle about 10 barrels of charging stock per day. This unit consists of a cross-section of the commercial installations and therefore gives results which can be interpreted in terms of large scale operation. Quite a variety of charging stocks have been run in an endeavor to learn something of the behavior of these oils under the conditions found in vapor phase cracking. Although these runs were of short duration (24 to 48 hours) it was discovered early in the work that they were readily duplicated and that runs of longer duration added little of value to the results obtained in the short runs.

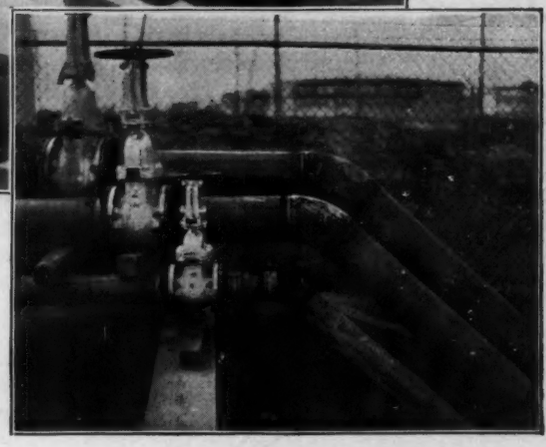
Below are given results of several runs on various grades of charging stock. Comparison may also be made between different throughputs and lengths of converter tube in the case of Cabin Creek gas oil.

From the data given in accompanying table it appears that the process is applicable to a wide variety of charging stocks. Inspection of the distillates produced from these various charging stocks shows a remarkable similarity, if they are all rerun to the same boiling point specification. Analyses made of the gases produced also indicate that the character of the charging stock has little to do with their composition. It stands to reason from a study of the cracking reaction that a light charging stock should yield a higher percentage of distillate than a heavy one, since decomposition of the molecules needs to be less profound. In many cases, however, the yield

| Charging Stock | Cabin Creek Gas Oil | Cabin Creek Gas Oil | Recycle From Cross Stills | Seminole Gas Oil | Winkler Gas Oil | Toped Sweet Lake Crude | Liquid Phase Recycle from Winkler Gas Oil | Mexican Gas Oil | Ranger Gas Oil | Heavy Venezuela Crude Oil | Topped Seminole Crude |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Length conv. tube | 40 ft. | 60 ft. | 40 ft. | 40 ft. | 40 ft. | 40 ft. | 40 ft. | 40 ft. | 40 ft. | 40 ft. | 60 ft. |
| Throughput gals. /hr. | 61.4 | 93.5 | 58.5 | 60.5 | 59.2 | 63.6 | 59.4 | 61.2 | 60.7 | 79.8 | 102.4 |
| Temp. exit converter, °F. | 1100 | 1068 | 1112 | 1099 | 1108 | 1100 | 1128 | 1114 | 1112 | 1075 | 1067 |
| Gallons charged | 476 | 585 | 362 | 254 | 392 | 302 | 457 | 735 | 1225 | 582 | 629 |
| Per cent distillate | 64.0 | 63.8 | 53.9 | 57.5 | 56.2 | 49.2 | 59.5 | 56.7 | 54.0 | 42.8 | 47.1 |
| Per cent fuel | 6.3 | 6.0 | 21.0 | 17.7 | 18.3 | 27.8 | 18.4 | 11.0 | 14.0 | 42.1 | 33.9 |
| Cu. Ft. Dry Gas | 13050 | 13900 | 7760 | 5710 | 10300 | 7280 | 9250 | 20300 | 29120 | 6700 | 10900 |
| Per cent Dry Gas | 34.2 | 29.7 | 26.8 | 27.9 | 29.1 | 30.1 | 25.4 | 34.7 | 29.7 | 14.4 | 21.7 |
| Cu. Ft. Gas/gal. dist. | 42.8 | 37.2 | 39.8 | 39.1 | 41.5 | 49.0 | 34.0 | 48.8 | 44.0 | 35.1 | 36.8 |
| Recirculation ratio | 3.09 | 3.82 | 3.88 | 5.71 | 3.64 | 5.19 | 3.12 | 4.11 | 3.57 | 3.30 | 4.59 |
| Grav. of dist. | 54.8 | 54.9 | 48.1 | 50.1 | 46.5 | 49.9 | 45.9 | 57.5 | 53.6 | 52.6 | 51.3 |
| Initial | 9.7 | 100 | 104 | 102 | 100 | 99 | 95 | 82 | 94 | 101 | 112 |
| 10% | 168 | 152 | 174 | 173 | 174 | 149 | 164 | 135 | 140 | 162 | 168 |
| 20% | 201 | 191 | 216 | 206 | 210 | 188 | 220 | 164 | 172 | 194 | 204 |
| 50% | 288 | 294 | 318 | 303 | 308 | 290 | 336 | 250 | 276 | 284 | 300 |
| 90% | 389 | 410 | 407 | 395 | 400 | 416 | 397 | 363 | 397 | 382 | 398 |
| End Pt. | 424 | 435 | 441 | 422 | 431 | 438 | 417 | 396 | 426 | 414 | 426 |
| Iodine No. | 206.2 | 209.8 | 190.7 | 205.8 | 218.2 | 217.5 | 168.6 | 251.4 | 230.7 | 162 | 170 |
| Ref. Index $(N)_D^{20}$ | 1.4328 | 1.4327 | 1.4480 | 1.4438 | 1.4448 | 1.4441 | 1.45216 | 1.4289 | 1.4362 | 1.434 | 1.4405 |
| Grav. of fuel | 13.6 | 11.1 | 10.2 | 9.4 | 7.1 | 12.1 | 7.5 | 13.6 | 7.4 | 3.0 | 11.9 |
| Sp. Gr of Gas | 1.089 | | 1.012 | 1.020 | 1.080 | 0.985 | | 0.985 | 0.996 | 1.00 | |
| Additional dist. available by treating gas | 16.5 | 14.3 | 12.8 | 13.5 | 15.8 | 14.5 | 12.1 | 16.6 | 14.3 | 6.9 | 10.4 |
| Total dist. available | 80.5 | 78.1 | 66.7 | 71.0 | 72.0 | 63.7 | 71.6 | 73.3 | 68.3 | 49.7 | 57.5 |



10" and 12" TUBE-TURNS in a Pipe Line Manifold.



# *The most advanced practice . . . in Manifold construction*

**THIS all-welded manifold fitted with TUBE-TURNS *represents the most advanced practice in manifold construction.* . . Welding produces what has thus far proven to be the only *permanently tight joint.* . . TUBE-TURNS are *stock fittings* specially designed for the welded job. They provide strength at all temperatures and pressures *equal to the piping with which they are used.* Their smooth inner walls offer minimum resistance to flow on short radius turns. . . In pipe lines TUBE-TURNS materially lessen turbulence and reduce pressure drop—hence lower pumping costs. As they can be cut on the job to any desired angle, a small stock will provide any change in direction, saving the time and expense of making hot or cold bends in the field. TUBE-TURNS, *Incorporated,* 1256 Logan St., Louisville, Ky.**
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85 - 170 B.H.P. ENGINE COMPRESSOR

BUILT AS SINGLE OR TWIN UNIT

# TYPE 80

ALTHOUGH existing types of Cooper engine compressors are performing in a manner thoroughly satisfactory to owners and operators, Cooper-Bessemer engineers are constantly seeking ways to make these units still better. Out of scientific research, laboratory tests, advanced engineering, modern equipment and materials, has been developed a new and improved Type-80—an engine compressor that offers even greater value than the models preceding it. Some of the refinements found in the new Cooper Type-80 are; a new and better breather compartment; special heat-resisting exhaust valves; longer power cylinder liners; larger inlet valves; improved exhaust chambers; better water cooling throughout, and more efficient compressor cylinder valves.

The New Type-80 is looked upon as simply a larger Cooper built smaller - with every detail cared for to insure lasting, economical and dependable operation. It is the 4-cycle, horizontal, direct-drive type, built as a single cylinder—85 B.H.P., and as a twin cylinder—170 B.H.P. Its chief applications are air and gas lift, gas boosting, gasoline extraction from gas, gas compressing, handling still vapors and weathering gases in refineries, air compressing, and repressuring oil sands. *Write for Bulletin entitled* - "THE NEW AND IMPROVED TYPE-80 COOPER GAS ENGINE COMPRESSOR."

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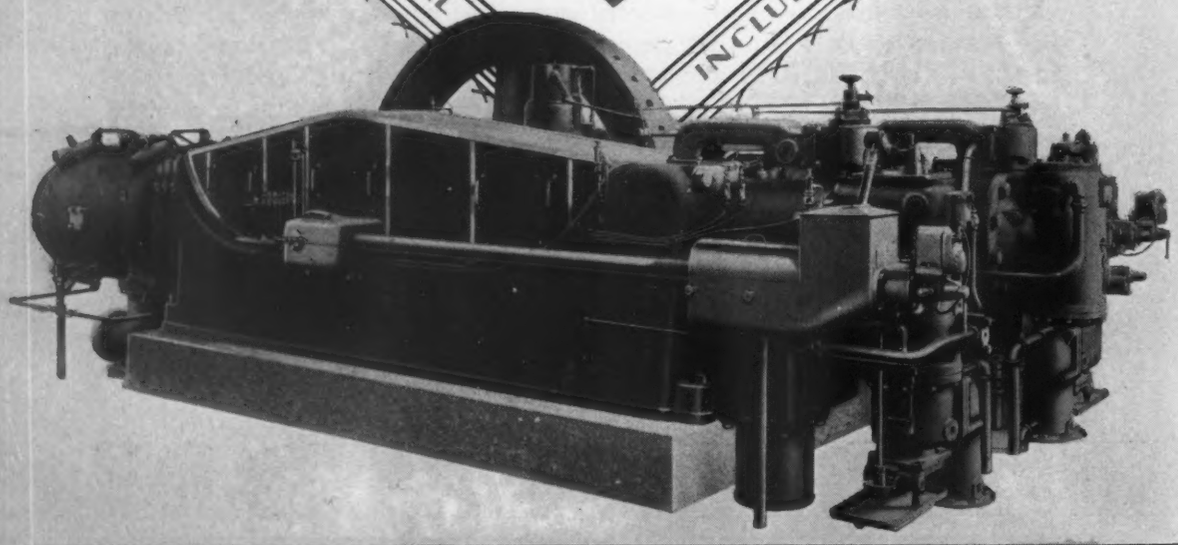
INCLUDES LARGE ENGINE FEATURES



THE COOPER-BESSEMER CORPORATION

50-60 B.H.P. ENGINE COMPRESSOR

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# TYPE 16

THE first Cooper Type-16 engine compressor units built have been in use over two years. With the exception of a few changes and refinements which were found necessary, these units have been practically free from trouble.

Type-16 is small, compact, self-contained—the engine and compressor being built into one direct-drive unit. It is rated at 50-60 B.H.P., depending upon the speed. The unit is shipped completely assembled, and is readily convertible for either gas or diesel operation. Using single or two-stage compressor cylinders, its range is from 26 inches of mercury vacuum suction to 2000 pounds discharge pressure.

Type-16 has the fuel economy inherent in 4-cycle engines; its semi-automatic operation effects a material saving on labor; rugged parts and solid construction reduce maintenance costs; and the consumption of lubricating oil is low.

Within its power rating, its applications are the same as for Type-80, plus belt-driving power equipment. *Write for Bulletin entitled*—"COOPER TYPE-16 COMPRESSOR UNIT."

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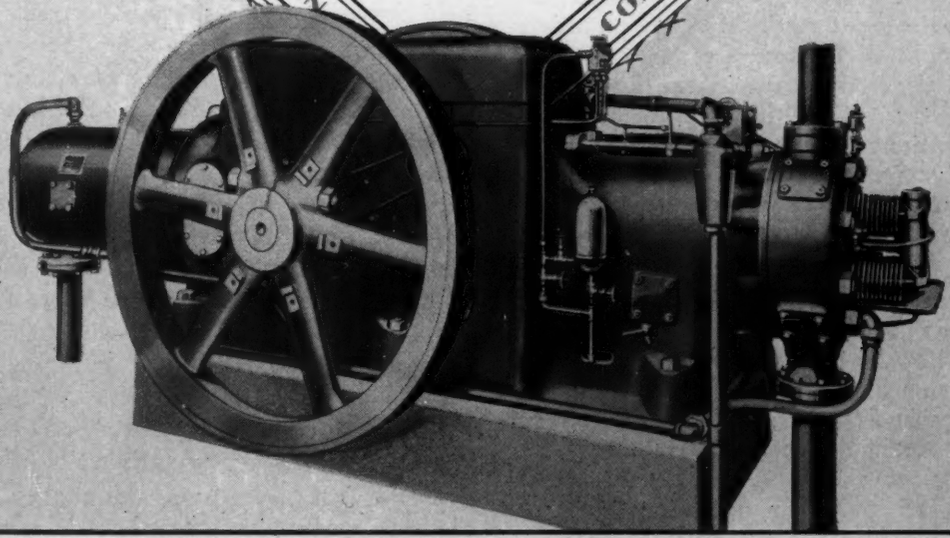

MT. VERNON, OHIO & GROVE CITY, PENNA.

# PROCEEDINGS OF WESTERN PETROLEUM REFINERS' ASSOCIATION

of distillate will be determined by the quality of fuel oil which must be produced.

### ASPHALT RESIDUE A FINAL PRODUCT

At this point the true flexibility of the process becomes evident. Even a casual inspection reveals that we have here four separate operations involved, each one an individual problem, but all co-ordinated into one process. The economizer and evaporator constitute an ordinary tube still unit for the production of vapors and a fuel oil residue. To increase fuel viscosity it is necessary to increase the quantity of steam, or in some other way to increase the percentage vaporized without cracking the residue. To decrease fuel viscosity one may increase fuel production, or the oil line temperature may be raised enough to cause mild cracking. If carefully done, this latter method will result in decreasing fuel percentage as well as viscosity. By the same token it is possible to operate so as to make an asphalt residue as a final product instead of a fuel oil.

The second operation involved is the cracking of the vapors in the converter. As can readily be seen this operation may be varied at will so as to secure the desired products and yields. This constitutes the only special piece of equipment in the Gyro Process, and represents less than 30 per cent of the total cost of the installation. The converter has a specially designed furnace intended to utilize in the most efficient manner the radiant heat generated by combustion of the fuel. Care is taken that the rate of heat absorption by the vapors in their passage through the converter is proportioned to the needs of reaction. Thus in the first few feet heat is absorbed at a rate in excess of 75,000 B.t.u.'s per square foot per hour, but farther on this rate is dropped to that necessary to maintain the temperature of reaction. In the beginning of the development work when recirculation of flue gas was employed difficulty was encountered in utilizing all of the waste heat in the flue gases leaving the converter. With the improvements in furnace design mentioned above the same heating is now done with five feet of tubing which formerly required 10 feet and the waste gases are insufficient in quantity to vaporize the gas oil required by the process.

The third unit in the process is the fractionating apparatus. For this purpose ordinary refinery equipment may be used. The heat abstracted in producing reflux has been utilized by converting the refluxer into a low pressure steam boiler. In this way sufficient heat is obtained, when added to that recovered in cooling recycle stock, to produce all of the steam used in all pumping operations and to evaporate the distillate in the rerunning operation. It is therefore apparent that fuel consumption figures quoted for this process include cost of steam and rerunning and due consideration should be given this fact in comparing with other processes.

The fourth part of the system is the gas recovery plant. For this work either compression or absorption may be used, but great care should be taken to return all of the product so recovered to the raw distillate produced. Due to the fact that it is almost 100 per cent unsaturated, it possesses very high antiknock value, and it also requires treatment similar to that given the remainder of the distillate in order to produce a suitable motor fuel. Since the fixed gas comes off the look box at almost atmospheric pressure it is saturated with motor fuel fractions and may run as high as five gallons per thousand cubic feet. Approximately 20 per cent of the distillate made therefore is recovered from the gas.

### NO CORROSION WORRY

A feature of low pressure vapor phase cracking which appeals to the refiner who runs a high sulfur crude is the desulfurizing character of the reaction and the freedom from worry over corrosion problems. When cracking a high sulfur charging stock the distillate obtained will have a sulfur content of about 50 to 60 per cent that obtained by producing the same boiling point distillate by liquid phase cracking. This appears to be due to the fact that a much higher percentage of hydrogen sulfide is split off which appears in the fixed gas. It would seem probable at first that this fact would lead to increased corrosion problems, but examination of the temperature gradient through the process reveals some interesting facts. It will be noted that in the economizer and evaporator the temperature is low enough to avoid material cracking and the consequent production of large amounts of $H_2S$. corrosion in this part of the apparatus will not be great, therefore, especially since all of the light fractions have been removed and the entire body of oil passing through the economizer has been held for some time at temperatures between 475° and 550° F. In the converter the temperatures are right and sufficient $H_2S$ is present to cause corrosion at a very rapid rate. The use of calorized steel or stainless steel parts, made necessary by the very high temperatures and oxidizing conditions in the furnace gases, effectively prevents excessive corrosion in this part of the equipment. Since the temperature is reduced to 600°F. or less in the arrester and is maintained below that figure for the remainder of the apparatus, little corrosion is encountered in vapor lines and towers. As is well known, it requires temperatures in excess of 600°F. or high velocities at lower temperatures to cause continued corrosion by hydrogen sulfide.

In the first place it was the quality of the product alone that caused the refiner to turn to vapor phase cracking methods. It is therefore with considerable gratification that he can now reflect that he has a process which not only produces that same quality of product, but in addition produces it in quantities and at costs which compare favorably with the production costs of liquid phase cracked gasoline.

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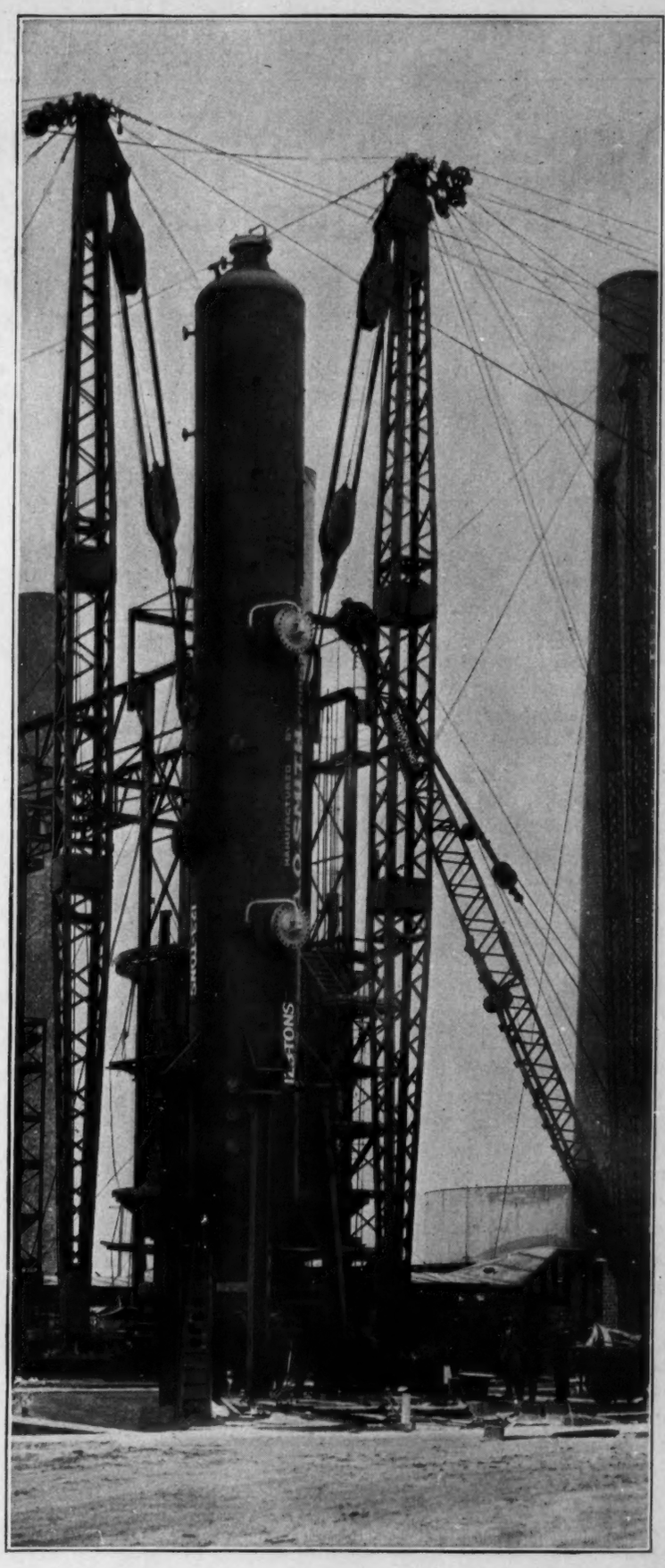

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# CRACKING STILLS

PROCEEDINGS OF WESTERN PETROLEUM REFINERS' ASSOCIATION

# Application of Vacuum Distillation to The Production of Lubricating Oils

By EARL PETTY
*Smith Engineering Company*

FOR a number of years the application of vacuum distillation to the production of lubricating oils has attracted the attention of the refining technologist and the equipment manufacturers. However, it is only within the past year or two that the refiner himself has become interested. The tardy development of this interesting process may be attributed to the lack of proper appreciation of the refiners problems on the part of many of the equipment manufacturers and also to the market conditions. During the past few years the decrease in the amount of green crude available as compared to market demands in the Mid-Continent area, the desire for decreased operating costs, and the ever increasing demand for oils of high physical properties has focused the attention of the refiner on this subject.

This process has interesting possibilities for every manufacturer of lubricating oils, whether he is processing paraffin base oils or asphalt base oils or the so-called mixed base crudes. Naturally the procedure for handling these rather distinct crudes differs somewhat. In this discussion we are pre-supposing the use of pipe stills provided with efficient fractionating equipment and it might be well to comment that the development of this combination equipment has been a vital step in bringing the present systems of vacuum distillation into such prominence and favor.

The general plant arrangement and method of operation as shown in Figure 1 follows. A reduced crude representing approximately from 40 to 50 per cent. of the whole crude is pumped through a system of heat-exchangers to the pipe still, where it is heated to the temperature to vaporize the desired distillate products.

Great care should be taken in the design of the pipe still so that the temperature of the oil film next to the tube wall is held within a very few degrees of the average temperature of the oil stream. Otherwise the purpose of the system of operation will be defeated. After leaving the pipe still the hot reduced crude is flashed into the vaporizer section of the fractionating column in the presence of steam. The vaporized portion ascends the rectifier section of the tower where it is counter-currently contacted with reflux supplied at the top of the column, thus removing the undesirable heavy asphaltic materials of higher boiling range. The overhead vapors enter a tubular condensing system, so designed as to condense the oil in two portions. The separation realized by fractional condensation is usually sufficiently close for the products being handled. The more viscous lubricating stocks are taken as side drawn streams. Only one stream is taken where paraffin crudes are being handled but two or more such streams may be taken when asphaltic oils are being distilled. The asphaltic bottoms are counter currently stripped with super-heated steam in the stripping section of the tower.

### PARAFFIN BASE CRUDES

Where paraffin base crudes are being processed, the light ends down to and including part of the gas oil are removed by steam-atmospheric topping units and the reduced crude, containing the wax distillate, the highly viscous fractions, and the tar, is charged directly to the vacuum pipe still and flash vaporized in the vaporizer section of the tower. The wax distillate and the high viscosity stock are vaporized and pass upward into the rectifying section of the tower where they are closely fractioned by virtue of being passed counter flow to wax distillate reflux which is pumped in at the top of the tower over the fractionating plate and bubble cap system.

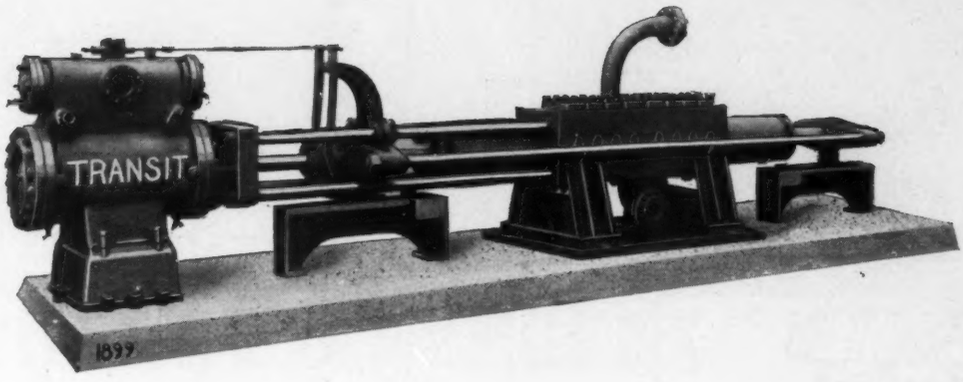
The wax distillate passes from the top of the column in the vapor form and the vacuum refined stock is taken as a side drawn product.

The unvaporized bottoms, along with the high boiling range liquid from the rectifying section flow down through the stripping section in counter flow to the superheated steam introduced at the bottom of this section thus removing the last traces of the valuable viscous oil materials and at the same time lowering the vaporizer temperature required to vaporize the stocks and wax distillate.

The wax distillate as handled above, is directly pressable without further processing or re-distilling and can be produced in practically any viscosity desired by manipulation of the amount of gas oil removed by partial condensation. When handling pure paraffin or mixed base crude and making a vacuum refined stock of from 150 to 160 vis at 210° F. as a side drawn product, the end point of the whole wax distillate cut will not be too high and will not carry inhibiting materials which will prevent pressing. It has been demonstrated in commercial units that this material can be pressed in viscosity range as high as 120 at 100 F.

Determination of the viscosity of the pressing stock is made by the following conditions: The lower the viscosity the higher the rate of filtration or pressing but entails a liquid burden of gas oil which makes a fluid burden for equipment, added refrigeration and re-distillation plant load. The higher the viscosity of the wax distillate the lower the filter press rate, but reduces refrigeration requirements, gives higher yield of viscosity material from material chilled and pressed and requires less re-distillation capacity. If a plant has limited filter

# The "Spare" Idea
# TRANSIT HOT OIL PUMPS




**Many refinery engineers use the "spare" idea to insure continuous hot oil pump operation. That is, an extra pump of equal capacity to any other of the hot oil pumps is installed. Generally this extra pump is kept in operation, and a slow speed, easy running and consequently long lived installation is the result. When it is necessary to shut down one of the hot oil pumps, the capacity of the remaining pumps, or pump is sufficient for the needs.**

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# PROCEEDINGS OF WESTERN PETROLEUM REFINERS' ASSOCIATION

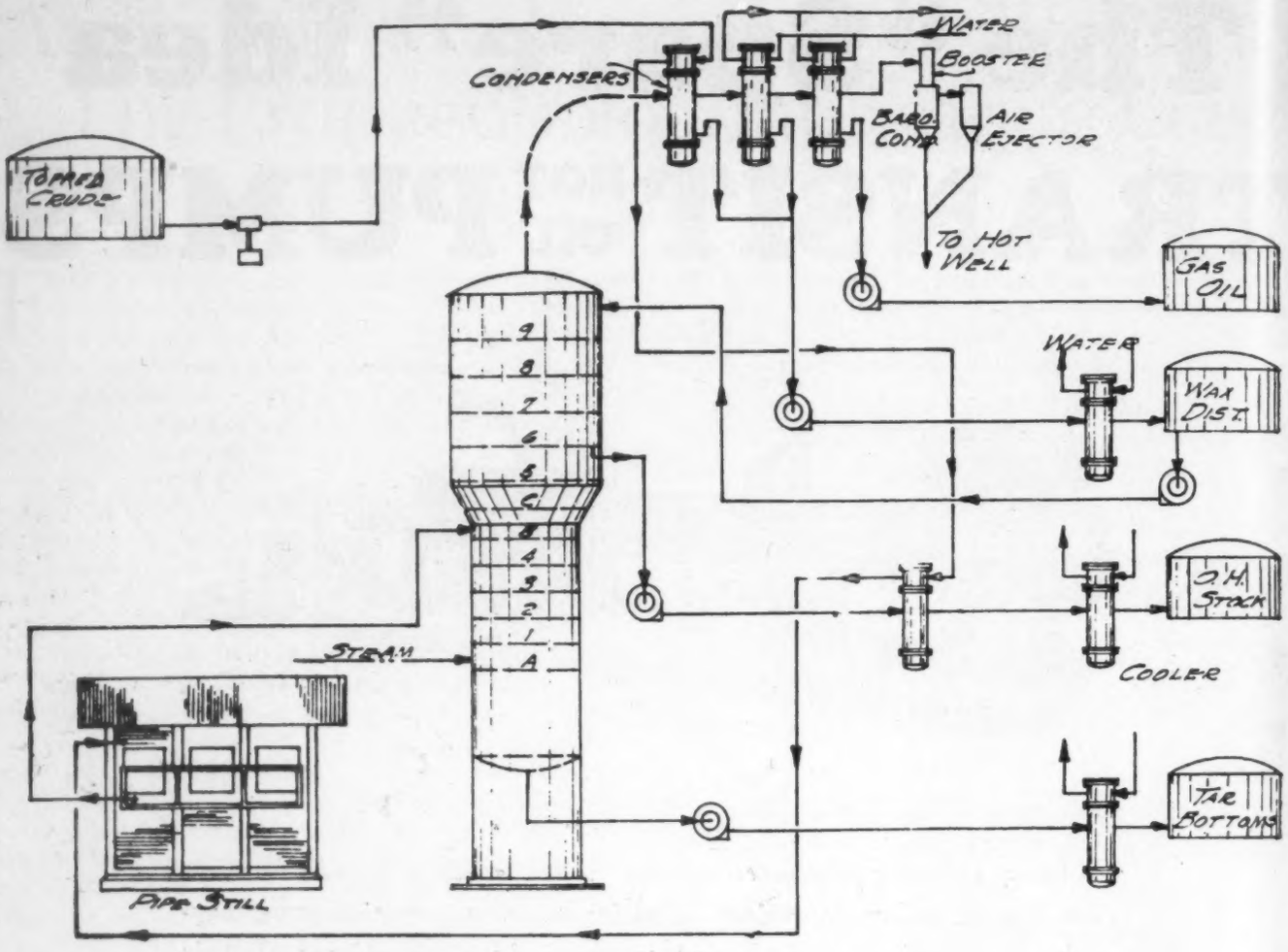


FIGURE 1
*Flow chart of Vacuum Distillation Unit for Wax Bearing Crude*

press capacity but plenty of refrigeration then a low viscosity wax distillate would be most practical. If a plant has excess filter press capacity but limited refrigeration a more viscous material might be pressed.

### TREND TO VISCOUS WAX DISTILLATE

A definite trend is to make a more viscous wax distillate, viz: 80-90 viscosity for straight pressing and also to make even a 100-120 viscosity stock and then dilute with a less viscous material such as naphtha or light gas oil to reduce viscosity and increase flow rate through presses, but at the same time bring in the minimum fluid burden. The viscosity of the vacuum refined overhead stock may be varied in viscosity from 90 seconds at 210 to 160 at 210. Through this range the stock can be readily dewaxed by the centrifuge, filter-aid or selective solvent method. The plan of dewaxing a whole heavy lubricant overhead stock similar in range of viscosity to long residuum is much more easily carried out than on long residuum stock. The viscosity of the stock to be processed is determined by the equipment available and the products which it is desired to produce. For example, it has been found in the production of zero cold test motor oils, a neutral and bright stock can be made from a stock from 90 to 110 viscosity at 210 F. most economically. The determination of the viscosity of the material to be dewaxed by combination pressing and centrifuging revolves around the capacity balance of the equipment available, the value of light non-viscous neutrals. This will determine the relative cost of the two methods. By centrifuging a 90 viscosity vacuum refined stock the dewaxed material can be broken up into a heavy neutral and a conventional bright stock by means of a rerun unit, and by this method all the 300 viscosity or even 250 viscosity at 100 F. neutral will have been dewaxed by the centrifuge operation. This leaves all the lower viscosity wax distillate to be pressed or charged to cracking material. If a whole wax distillate is pressed for 300 viscosity neutral only, and the total cost of the operation charged to this single material, it will make the pressing cost higher than that of centrifuging in a long vacuum refined overhead. Needless to say it is impossible to centrifuge a 300 viscosity wax distillate alone but a material similar to the conventional long residuum can be centrifuged. In Europe in 1923 the writer successfully centrifuged on full size operation an 80 viscosity overhead stock make an BKM (Brunen Koenigsfelder Machinenfabrik equipment). This product was made on a battery of continuous stills which were operated with only partial condensing-fractionating equipment under absolute pressure of 45 to 65 m/m

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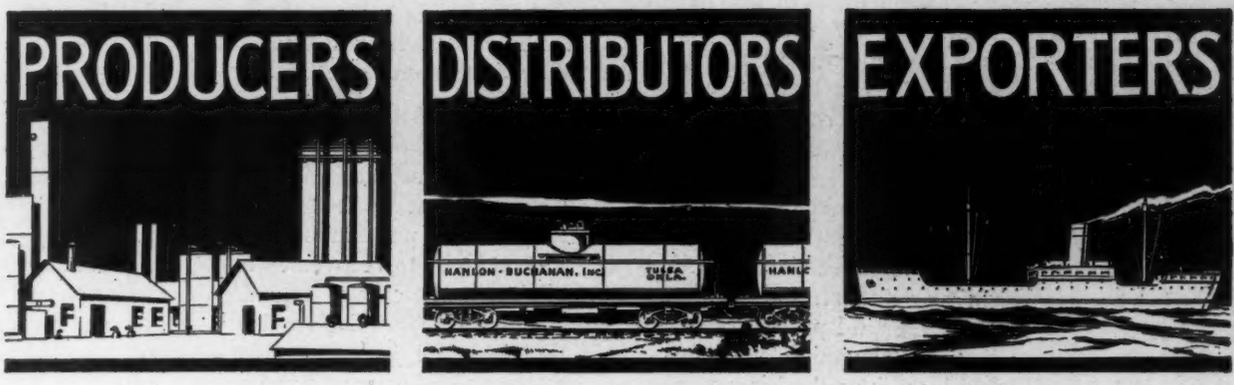


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of hg. Since that time I have had great enthusiasm for the process of dewaxing overhead stocks and we are just about to see the acceptance of the method in this country by the use of equipment which offers every reason for giving improved results.

## PROBLEMS OF DEWAXING

By the filter-aid method which is just now being given new life due to certain process details and improvements, and due to the backwardness of centrifugal engineers to tackle the dewaxing of these overhead stocks, especially the longer cuts, an entirely new problem of the economics of dewaxing is facing us. It offers the advantage of being a little less critical of control as to nature of stock being handled, less dilution is required, less delicate chilling process, less refrigeration due to less diluting material and closer gap of cold test and temperature. Its handicaps are that it involves more process and mechanical details. Solvent methods of dewaxing are always being demonstrated on a commerical basis independent of filter aid process and centrifuge process. Regardless of dewaxing process the overhead stock as produced by this method is a narrow range boiling material which has been fractionated under conditions which prevent cracking and it possesses physical characteristics decidedly different from those of a residual product. The initial boiling point may be rather closely regulated and there are sufficient plates to produce a closely fractionated product, passing all coloring matter or asphalts of higher boiling range into the pitch drawn from the base of the tower. By this method we obtain a maximum flash-viscosity relationship and extremely light colors. Stocks prepared in this equipment usually have from 30 to 50° F. higher flash for a given viscosity than a residual stock produced from the same crude. The color of the material directly off the tower will be found to be practically the same as that of a well treated residue stock after being processed with from 35 to 40 pounds of acid per barrel by the conventional treating method. It will be noted, of course, that this vacuum refined stock will have considerably higher cold test than even the acid treated stock. This does not mean that a larger per cent. of wax is segregated into this cut but indicates that the waxes are not dissolved or hidden in excessive inhibiting coloring material. It will be found that the cold test is more nearly the same as that of an acid treated and filtered residual stock. The vacuum refined overhead stock carries a balance between coloring matter and the higher boiling waxes in such a form that the wax is free to be percipitated by normal temperature effect as is indicated by the high cold test of the product, thus ranging from 75 to 100° F. This is due to the fact that this carefully fractionated material carries no high boiling coloring matter or asphalt, or coloring matter which has been re-arranged into lower boiling ranges by the cracking and by catalytic effect of asphaltic materials in the pitch at elevated temperature. These materials exert a colloidal solven effect on waxes, making it impossible to dewax by mechanical means.

It is also necessary to have a product stripped of the light end materials that tend to accelerate crystalline wax growth, and to remove materials from the heavy end which tend to dissolve and cover up the waxes. The results are accomplished in this new equipment hook-up and the stocks can be diluted and chilled in the conventional manner and dewaxed without further treatment or filtration. Treatment and filtration may follow the dewaxing operation to make finished color products. The pitch bottoms produced contain no coke or suspended carbon and are readily soluble in any of the lighter cuts or fuel oil and can be disposed of by blending and selling as fuel. This, of course, decreases the amount of acid sludge.

## ASPHALTIC BASE CRUDES

It is rather difficult to outline a definite procedure for handling asphaltic base oils as it is dependent to such an extent upon the characteristics of the crude itself. When paraffin oils are being processed it is a constant fight to recover as many viscous units as possible but in the case of asphaltic base oils the real battle is to obtain a good flash and for and lower the viscosity.

Due to the absence of waxes and the excessive amounts of coloring and unstable materials the problems become that of distillation, fractionation and acid treating. The simplest procedure is to reduce the crude in a separate topping stilling and then charge to the vacuum unit where it is fractionated directly into two or three separate cuts such as a neutral, a motor oil, and a bright stock, residueing the pitch material. Each of these cuts must be refined or treated separately to make marketable products. This brings in a complication in tower design where so many side streams are drawn due to plates required and the attendant pressure drop, making it necessary to operate the vaporizer section of the tower at a higher pressure than when making only one side drawn material. This of course raises the temperature condition. Recent work carried out in Germany indicates that stocks distilled at too high a temperature in the presence of their asphaltic materials suffers some decomposition due to the catalytic action of the asphalt. The other alternate of distillation is to charge the reduced crude to a vacuum unit, similar to that used on paraffin base oils and make a total of lubricant cuts similar to the total wax-lube cut and then treat as a whole unit following with a re-run unit to make the required fractionation. This offers the disadvantage of there being a possibility of following even this last distillation by some treatment for final stability.

Since by vacuum distillation and best fractionation it is impossible to remove all coloring material, some chemical treating of the vacuum refined stock is required. This is accounted for by the fact that from a vapor phase to a condensate, some of the coloring material is of the same condensing temperature range as the lubricant cut. However, after once condensed, if re-distilled, it will be found that the coloring matter present in the liquid being heated and changed back to the vapor phase again, is of a higher boiling range and can be made a residue by the same equipment and method, i.e. by boiling range difference. It is the theory of the writer that this re-arrangement of boiling range is caused in the primary distillation, even though carried

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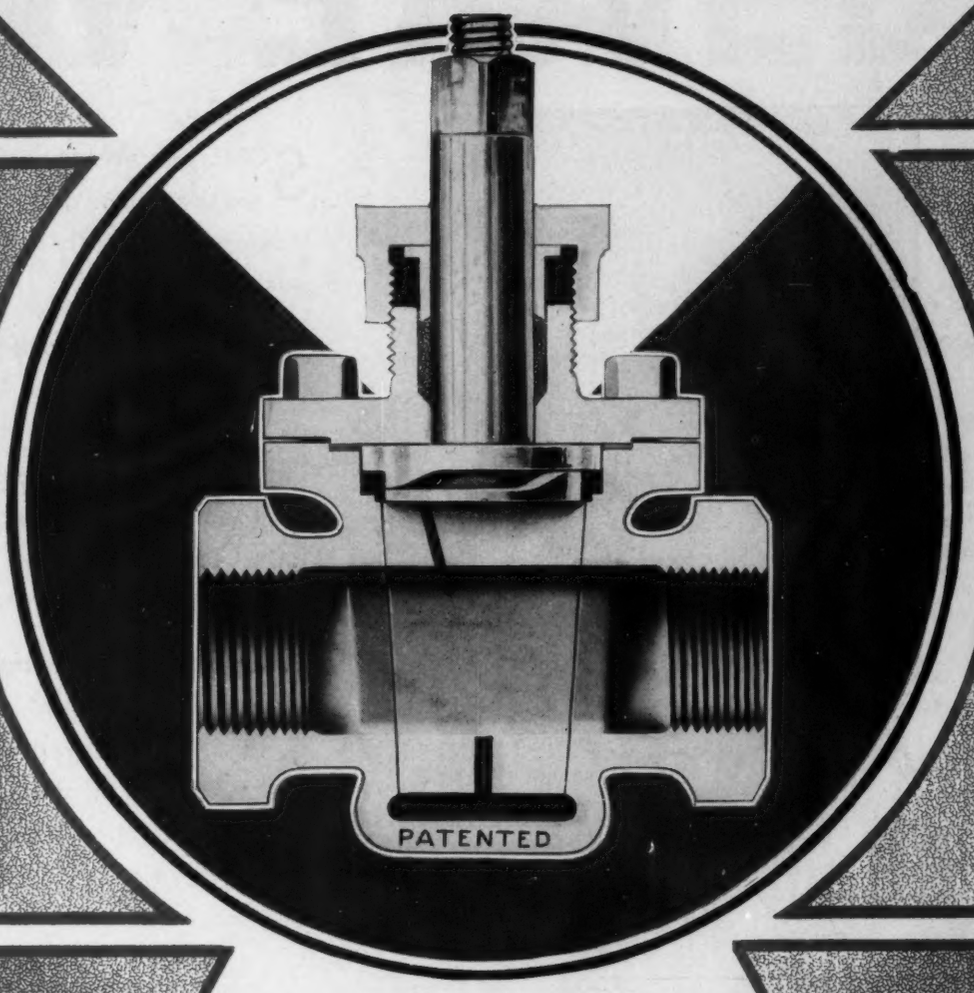


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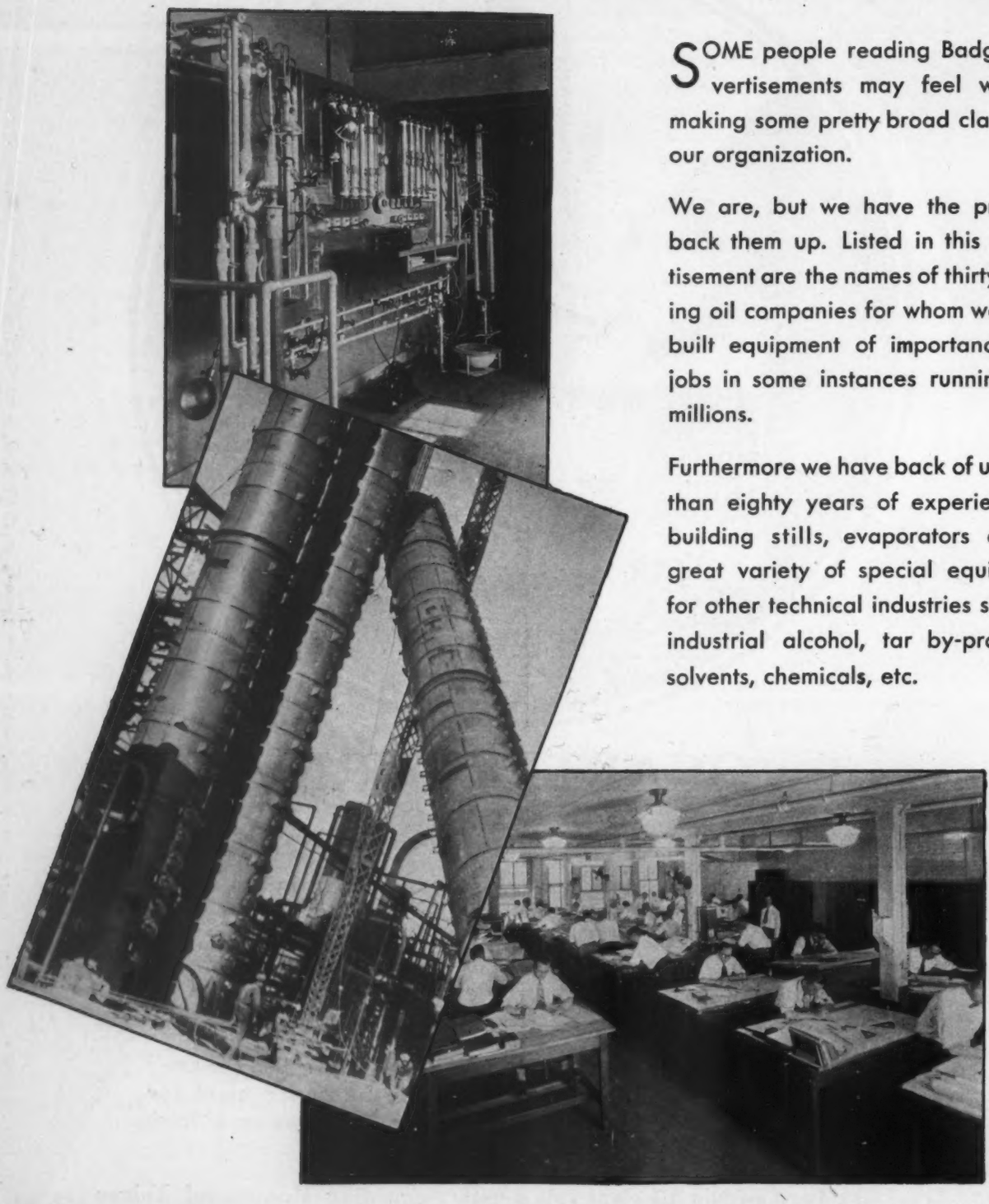

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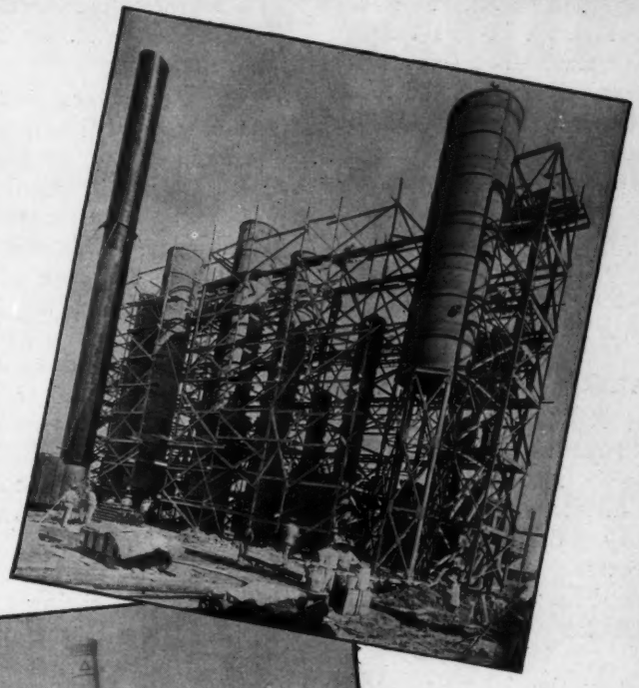

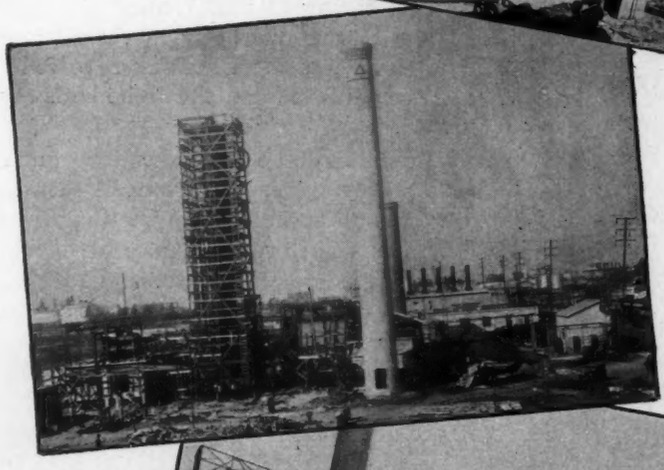

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Gulf Refining Co.
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Tide Water Oil Co.
Anglo-Persian Oil Co., Ltd.
Empire Refineries, Inc.
Marland Oil Co.
Vacuum Oil Co.
Associated Oil Co.
Barnsdall Corp.
Humble Oil & Refining Co.
Tidal Refining Co.
Standard Oil Co. of N. J.
General Petroleum Corp.
Beacon Oil Company
Lubrite Refining Co.
Pennzoil Company
Shell Company California
New Orleans Refining Co.
Emlenton Refining Co.
Independent Refining Co.
Richfield Oil Co.
The Texas Co.
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out under the reduced temperature of high vacuum, by the catalytic effect of the coloring material and had the asphaltic material concentration been reduced by some quantitative removal method, less re-arrangement would have taken place. Also, that parallel to re-arrangement of coloring material found in this case, a re-arrangement of the lubricant materials also was effected. This in the writers opinion explains the main difference in characteristics between lubricants made from mixed base crudes and from paraffin crudes. Therefore the removal of coloring materials quantitatively by chemical means, will best prepare an oil for fractional distillation, whether by vacuum or by steam atmospheric. Of course, if very high boiling range fractions are to be prepared vacuum distillation will be necessary to reduce temperatures and prevent cracking.

## SUMMARY

As indicated above, vacuum distillation coupled with fractionation offers many interesting features. The trend of vacuum distillation today is so closely coupled with fractionation that it is difficult to decide which to give the most credit. Personally, I think the fractionation equipment has put the process over. But the combination explains the progress being made, whereas vacuum distillation as previously known had made little progress.

For the credit of fractionation the following stock gives an example: A Pennsylvania topped crude was charged to a vacuum unit and gas oil and wax distillate taken overhead. A side stream of 65 viscosity at 210° F. 505 flash was taken and centrifuged. This left a residue stock of 152 viscosity at 210° F. with 590° flash. Similar stocks made by conventional methods without fractionation were of 450 flash for the 65 viscosity and 540 flash for the 150 viscosity.

Another example may be found in a Louisiana crude fraction of 65 viscosity at 210, 635 at 100° F. with a flash of 430° F.

Take the case of black Mid-Continent crudes as a source of raw material, using for example Seminole or Kansas crude, approximately 13 per cent of 520 flash 150 viscosity vacuum refined stock can be made or 10 per cent of 540° F. flash, 150 viscosity, or 8 per cent of 560 flash, 150 viscosity can be obtained.

To finish bright stock of from 7-8 NPA the vacuum refined stock will require from 6 to 8 pounds of 66 $H_2SO_4$ per barrel and require slight straining of 4 to 6 pounds of clay per barrel for neutralization and de-blooming.

To finish bright stock of 5-6 NPA from 20 to 24 pounds of acid will be required and from 4-6 pounds of clay per barrel for neutralizing and de-blooming.

The above mentioned quantity of clay is required for neutralization only and when put on an acid oil that has been treated by the centrifugal method of separating sludge there is no pepper to remove and to accomplish the neutralization only slight heating is required to cause a further break between the oil and any dissolved acid that remains. This gives further decolorization but the primary use is in the neutralization.

It is readily seen that with the general application of vacuum distillation vacuum refined stocks will be obtainable from all black crude bottoms, and this new product will be of equal or better characteristics than our present treated straight run stocks from green crudes. This might immediately be interpreted to indicate that the advent of vacuum distillation means the same thing in the lubricant industry that cracking did to the gasoline business 10 years ago. However, there is another side to the picture and that is that the factor of improving quality and disregarding yields is most appealing to all of us and in reality vacuum distillation may bring us to such high standards of viscosity, boiling ranges and flash characteristics that our yields from black grade crude will be less than by the present system and if this should be the trend, with our ever increasing demand for lubricating oils of higher viscosity units, we may have to run a greatly increased amount of crude in order to get the fractions required for lubricating stocks, and discard the light ends for cracking materials.

Another trend will be to make new surveys and evaluations of various crudes from different sections of the country and process them by this new method and find what special fractions may be had for lubes by utilizing these modern units.

With vacuum distillation coupled with fractionation equipment applied to Gulf Coastal crudes an entirely new source of lubricants of new and surprising characteristics are found. The same is true of West Texas and Mid-Continent crudes.

Over all I think the various processes and phases of our lubricant industry has been more conservative about making changes in methods, equipment and process than has the light oil end of the industry. For ten years now the lubricant industry has been diligently studying these new possibilities. Vacuum distillation as a reality has not bursted out on us as a thunder bolt from a clear sky but has been through all our major laboratories and research departments and finally a fairly well co-ordinated system and hook-up of departments has been worked out correlating the various steps and phases necessary for making a full line of finished materials from any crude using vacuum distillation for both primary and secondary fractionations.

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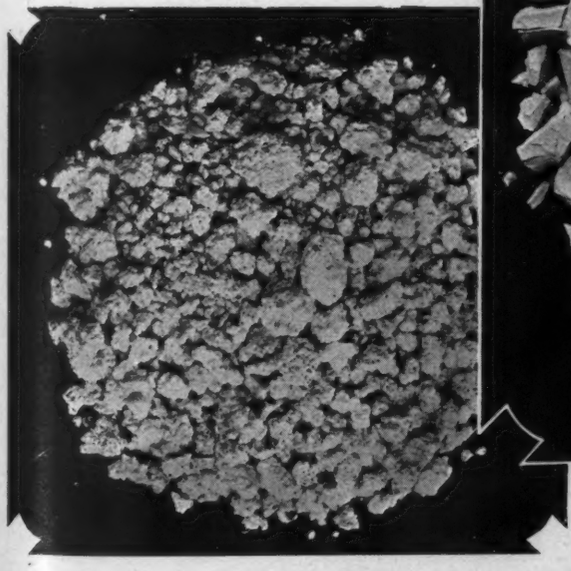
That's why we developed this *better* plastic refractory so carefully—made it a balanced refractory—gave it *mechanical strength, high refractoriness,* and unusual *chemical resistance* to slag, ashes, and other fluxes—each factor *in balance* with the rest.

*Check over these fundamental reasons why PX-33 will serve your plant better:*



Ordinary plastics often are made from re-ground cull brick. Note absence of angular structure. Linings of this material have slight strength and *lack the skeleton to resist spalling.*

The refractory basis of PX-33. Note strong, angular flakes of unused calcined flint clay which make a keyed skeleton in your furnace wall, arch or patch. Minimum spalling under thermal shock; green and fired strength; low shrinkage.

PX-33 is made by a fire brick manufacturer with 53 years of background in the refractory field.

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PROCEEDINGS OF WESTERN PETROLEUM REFINERS' ASSOCIATION

# Control of Refinery Operations With Instruments

By F. M. POOL
*Brown Instrument Company*

THIS subject: "Instrument Control of Operations in the Refinery" is one that, a few years ago, would have started an argument. It was not so long ago that instruments were looked upon somewhat unfavorably and as not being essential. Now we may still have the argument, but it is rather on what kind of instrument the refiner shall use than shall he use any instruments at all.

In your past meetings you have had papers read giving a resume and growth of instruments as applied to refineries. These papers, while serving to emphasize instrument importance—and that they are oftentimes the difference between a profitable and an unprofitable operation—have not been regarded as being particularly tangible or helpful to the everyday problems. I dare say the refiner has certain questions in mind he would like to ask; questions that have never been squarely met in discussions heretofore; for example:

"Why should this particular type of instrument be used?"—or, "What can be done to better my installation?"

In today's discussion I want to be limited to two particular aspects of this subject and to go into them sufficiently that there will be some concrete tangible benefit derived from them by the refiner.

If the refiner could know where he could get a complete and practical exposition of the merits and limitations of the several types of instruments offered, he would then feel more certain that he had acted to the best interest of his company in selecting this or that type of instrument for an application. He could feel more satisfied with his own judgment. Again, I imagine he would feel some elation if he had a little better knowledge of what instruments are capable of doing, which instruments are increasing in usefulness, and what additional work can be expected from them in the future. It is these two aspects I want to touch upon in this paper.

## THE TREND TODAY

From its extended use today, one may assume the pyrometer is perhaps the most important of the temperature instruments. A pyrometer, whether for oil temperatures, tower, or furnace, is usually selected for its (a) sensitivity, (b) remoteness of operation, (c) capacity of recording several related temperatures on one chart. Pyrometers, as used today, usually operate on one of two principles, the millivoltmeter or the potentiometer. One of the most pertinent questions is:

"Which is the better for my work in a refinery?"

For example, some, having in mind a comparison of the basic principles and the ultimate laboratory accuracy of each, may have asked themselves:

"Can I not utilize this superior Potentiometer

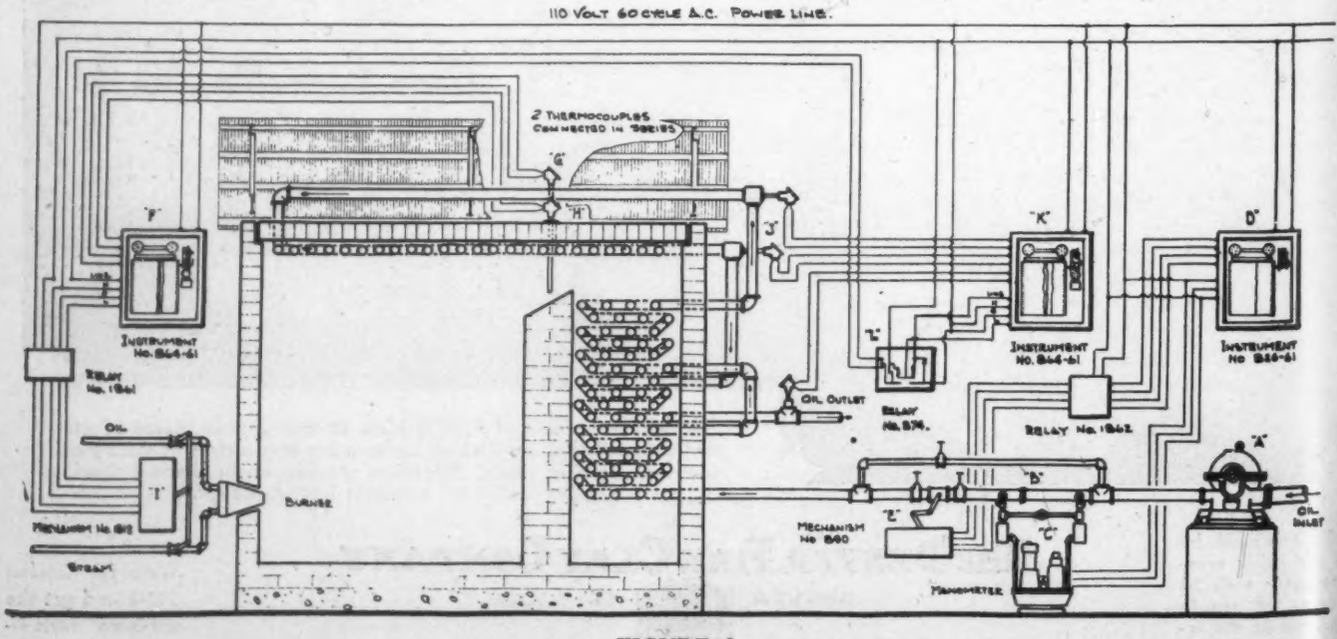
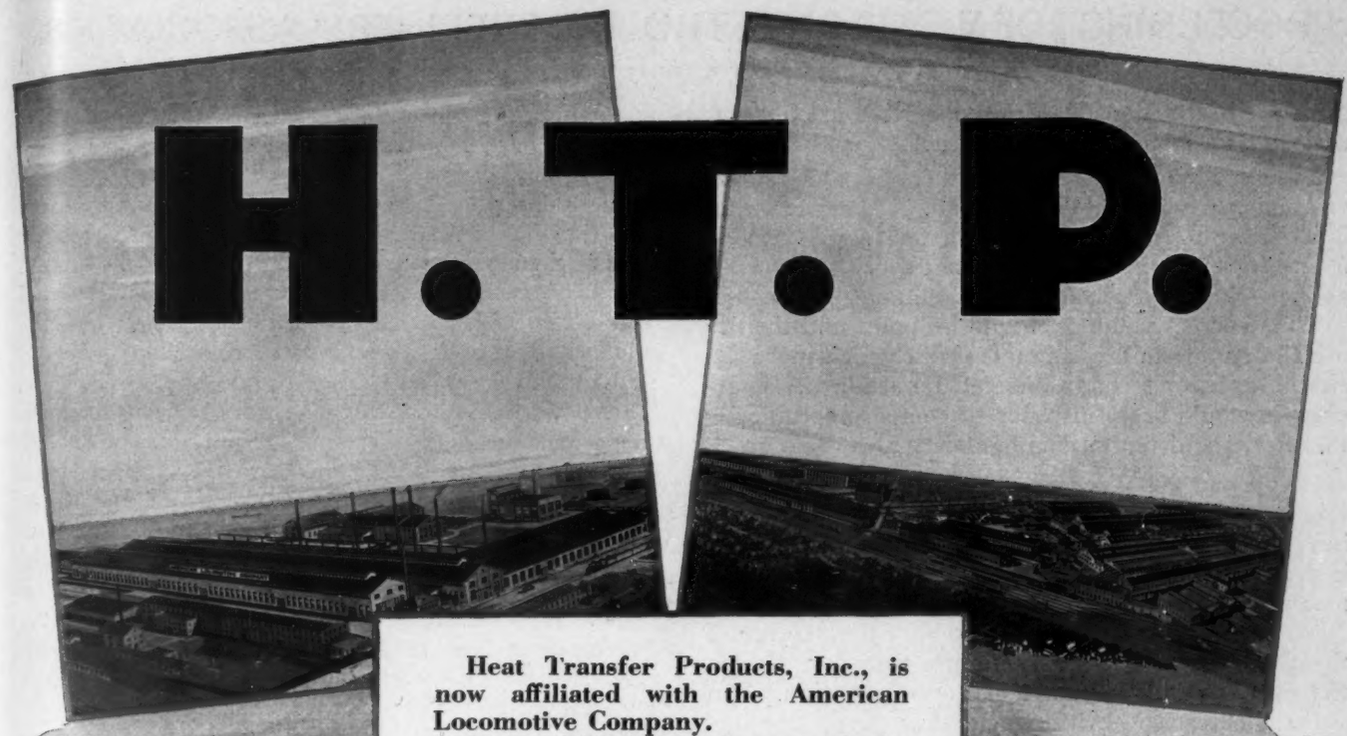



FIGURE 2
*Tube still control, bridge wall type—Brown Instrument Company*

# H. T. P.



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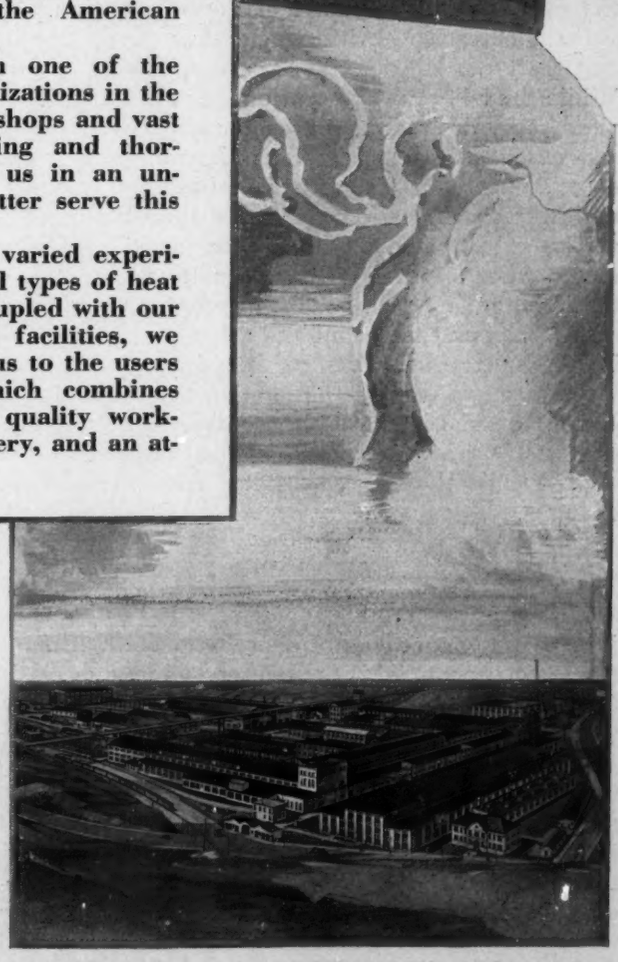

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principle in the instrument my operators use and get desirable operating characteristics?"

This is a question on which there is a difference of opinion. Some believe you can. Others feel that it is better to use the potentiometer in its simplest form—in which its accuracy is not sacrificed to ruggedness—namely, as a portable standard, to establish the correct value of the initial point and then to use the simple millivoltmeter—from which more desirable operating conditions can be attained. However, it would seem in order to compare specifically the merits and limitations of the two.

Earlier in the discussion I stated that sensitivity was one of the fundamental reasons why pyrometors have been selected in preference to other types of instruments. Sensitivity here can be interpreted to mean ability of the instrument to respond immediately to changes in thermal potential and to record them emphatically, with minimum time lag, so that the operator can make use of the information. The galvanometer is the heart of either pyrometer and that part which detects thermal potential changes. While the laboratory potentiometer can be built with almost any desired galvanometer sensitivity, the galvanometer sensitivity of the industrial potentiometer —particularly in the recorder—has, for reasons of design, a much greater limitation than the millivoltmeter galvanometer. Therefore, as the millivoltmeter galvanometer is more sensitive than the potentiometer, its record will represent a truer picture of the temperature trend and what took place. This is further true inasmuch as temperature changes always mean record fluctuations on the millivoltmeter chart; the sensitivity of the galvanometer is not a matter of critical mechanical adjustment. Temperature trend, therefore, results from temperature changes.

### TEMPERATURE TREND IMPORTANT

Temperature trend is rapidly coming to be classed just as important, if not more important, then extreme accuracy. This is apparent when one realizes the operator guides his unit as much from the temperature trend as from the actual temperature.

In remoteness of operation, either the potentiometer or the millivoltmeter can be regarded as satisfactory. The effect distance has on the potentiometer is to make its galvanometer even less sensitive due to the fact that the current value is decreased for a given unbalanced condition, which is the condition when there is a temperature change. In the millivoltmeter, the effect of distance, resulting from radical differences in lead lengths, is balanced out by internal resistance units which are adjusted once for any given installation. Variations from these lengths, arising from rewiring or relocating thermocouples, have no practical effect due to the high internal resistance used in the instrument. Radical lead length changes have no permanent effect on the galvanometer sensitivity, inasmuch as it merely means a balancing of the internal with the external resistance. However, either instrument can produce satisfactory records at a distance.

In making multi-record instruments for refinery use, the limiting factor is the time cycle. This is obvious when you consider the operator follows the trend of the temperature as much as the actual value. In this respect, the millivoltmeter has the advantage; it is direct acting in producing its record and therefore requires a minimum time to function. The potentiometer must go through several intermediate steps and, therefore, requires considerably more time to function. The comparison would run, say on a four-point instrument, about one minute on the millivoltmeter to about three and one-half to four minutes on the potentiometer; roughly the millivoltmeter is about 3½ times as fast in its time cycle. It is apparent that this is a definite factor in determining how many records you can afford to have on one chart—regardless of how related they are and how nice it would be to have them so recorded. This time cycle requirement has an even more important bearing in adapting instruments to do automatic control work.

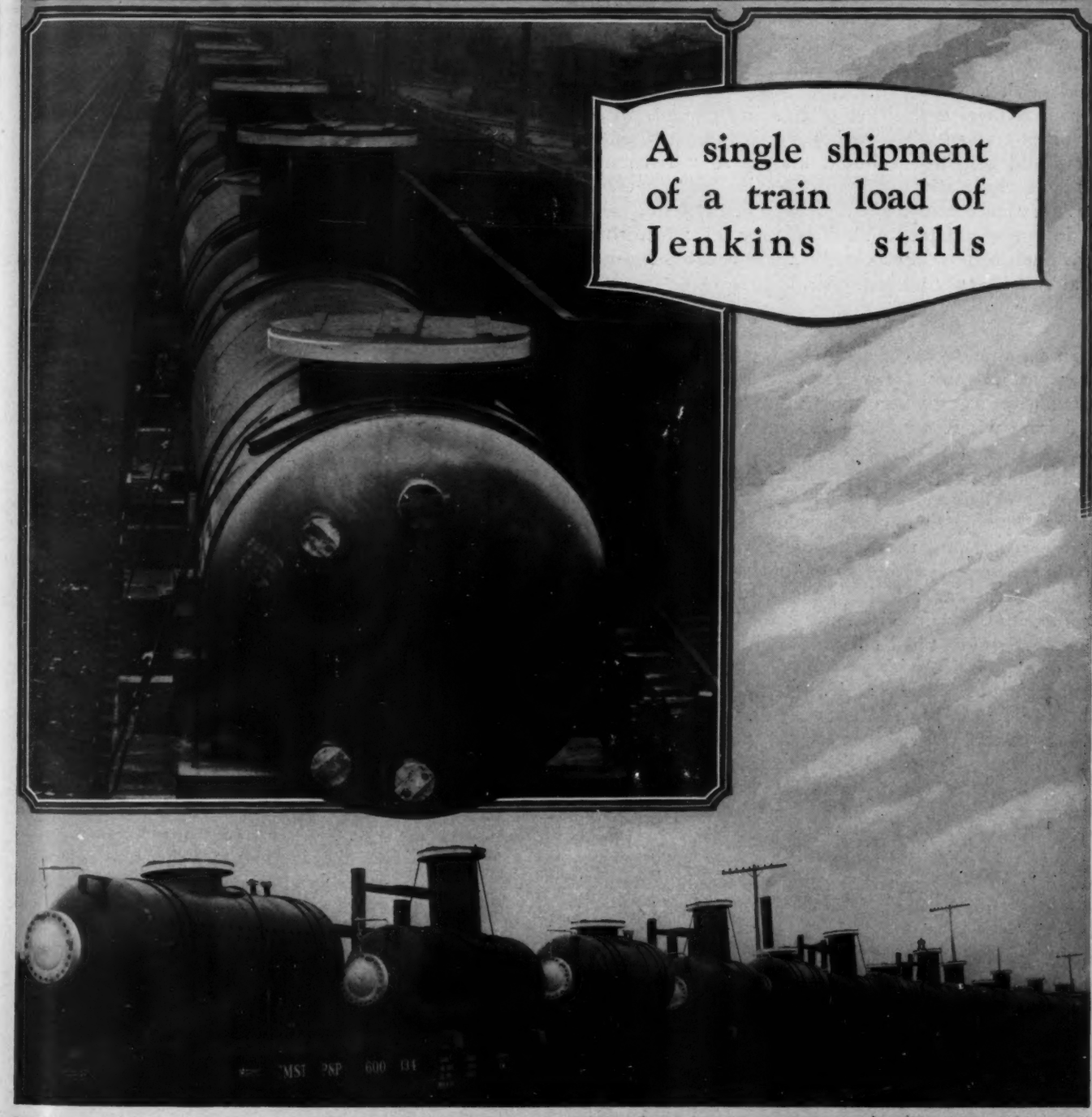
### THERMOCOUPLE LOCATION

In oil temperature thermocouples, particularly on cracking stills where coke is present, it is important that the area inside the tube in contact with the oil be materially greater than the area exposed to the outside air. It has been found that if about 80 per cent of the total area of the thermocouple well head, and extension is inside the tube, your heat input into the thermocouple will still be greater—even after coke covers the well—than the heat dissipation into the air. This means that the conduction error remains negligible and there is no perceptible falling off of temperature as the coke builds up on the thermocouple well. I have observed a Cross unit oil temperature thermocouple which previously had a drop of 30° F. due to coke building up, drop only 5° F. with a thermocouple so designed.

In tower temperature thermocouples, it is important that the thermocouple be located as near as possible—without being directly in it—to the point where the reflux mixes with the up-coming vapors from the top tray. To illustrate how much difference this makes, note the Chart "A," photostats Nos. 1, 2, 3, and 4 which have self-explanatory notations on them. The record shown is from an older type of control—the "off and on" type—which is now becoming obsolete, but the comparison of thermocouple location should hold regardless of the type of control.

Unfortunately, little thought, comparatively, has been given to improving furnace thermocouples. It is becoming more and more evident that furnace thermocouples, as now used, do not tell the whole story of furnace temperature. When one considers that in modern furnaces 60-75 per cent of the heat transferred is into the oil by radiation and only 25-40

# JENKINS CRACKING PROCESS

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per cent by convections, and that furnace thermocouples are affected primarily by convection, it is evident that some improvement is in order.

In the resistance thermometer we have an electrical instrument, of indicating or recording type, which is particularly adapted to low temperature work—whether 200° F. below zero or 200° F. above zero. A brief exposition of this instrument, which involves a wheatstone bridge, a galvanometer, a battery, and sensitive element known as a resistance bulb, is especially opportune in view of the extraordinary care and additional equipment being used to improve and free wax from lube oil, and also in view of the new methods being advocated for natural and refinery gas analysis.

## AUTOMATIC CONTROL

In passing to the second part of this discussion, there in no question but that automatic control is the phase that is becoming more and more useful and from which more can be expected in the future. In speaking of automatic control, a more broad interpretation is required. Real automatic control—from which great things can be expected—is not the isolating of one particular factor, such as tower outlet temperature, and the building of a control for that temperature, but rather the adapting of a synchronized control for all the factors present. For example, in the refractionating end, the tower outlet temperature should be blended with the liquid level and possibly also with vacuum controls. In the tube still end, the furnace and oil temperatures controls should be linked with flow control.

It is in this larger sense that the instrument manufacturer, who is in a position to build these various types of controls, can be of real service to the refiner.

To illustrate such blending, note Diagram A of typical tube still control:

Oil is pumped into the still tubes by the Pump A. The pressure differential across the orifice, B, operates the manometer, C, which causes the rate of flow to be recorded by the automatic control recording flow meter, D. This instrument causes the valve, E, to operate when the rate of flow rises or falls above or below a predetermined amount; thus maintaining correct oil feed to still.

At the same time, the automatic control recording pyrometer, F, is recording individually two thermocouples, G and H, located one at each end of the furnace also recording and controlling from the average still furnace temperature above the bridge wall by means of the thermocouples, G and H, which are connected in series as point No. 3. When the furnace temperature shifts from the point it is desired to maintain, the pyrometer operates the valve, I, regulating the oil burner feed, and the proper temperature is automatically and promptly restored.

Theoretically, if the oil is fed to the tubes at the rate determined correct under average conditions and the furnace is maintained at a constant temperature found satisfactory for that rate of oil feed, the oil temperature at the outlet should be continuously correct. In practice a number of variables upset such a constant hot oil temperature.

To compensate for these variables and act as a safety protection, the temperature of the oil leaving the roof tubes is taken by means of the thermocouple. J. connected to the automatic control recording pyrometer, K. Variation in the oil temperature from the predetermined maximum point causes the pyrometer to operate the relay, L, nullifying the furnace control, and at the same time reducing the fuel and holding it reduced until the oil temperature falls below the predetermined point—after which the furnace control, F, again resumes adjustment.

It should be noticed that one of the attendent hazards, usually present in the use of automatic control, is recognized and taken care of in this scheme. The natural reaction of the fireman, who is given automatic furnace fuel control, is to rely on it, which means less time spent around the furnace burners proper. To eliminate this hazard, by giving the fireman something definite to do regarding which he is checked, and at the same time so designed that the "heat input" is not affected if he neglects to do his part, the furnace pyrometer "F" is built as a three record instrument. Two of these records, record only the temperatures of thermocouples G and H. The fireman is given the responsibility of keeping his burners together so that these two records are together; if he fails to do so, his error is shown by diverging records. On the other hand, since the control of the furnace fuel is from the average of these two thermocouples on Point No. 3, the "heat input" remains constant regardless of how well the fireman does his part; the only point sacrificed, is that one burner may be temporarily overloaded with respect to the other.

Here we have the blending of furnace temperature control — heat input—with charging rate flow control—load on the unit—to give a constant hot oil temperature—the product.

## WORKING WITH FACTORS

It is obvious that the reverse could be done by simply reconnecting the same instruments, namely control of furnace fuel from hot oil outlet or a point back from the hot oil outlet, even with a safety protection against excessive furnace temperature. But, it seems more desirable to work along with "the factors" in the process of forming a product, rather than backward from the "product" itself. You have less time lag with which to contend and do not operate at a higher furnace temperature than you predetermine; the hot oil safety feature insures you against excessive oil temperature.

It is interesting to note in all controls; whether temperature, flow, liquid level, or vacuum, that the trend is of such great importance. The most improved type of control instrument now in use makes its adjustments, not from the actual temperature, level, or flow, but instead from an analysis of the

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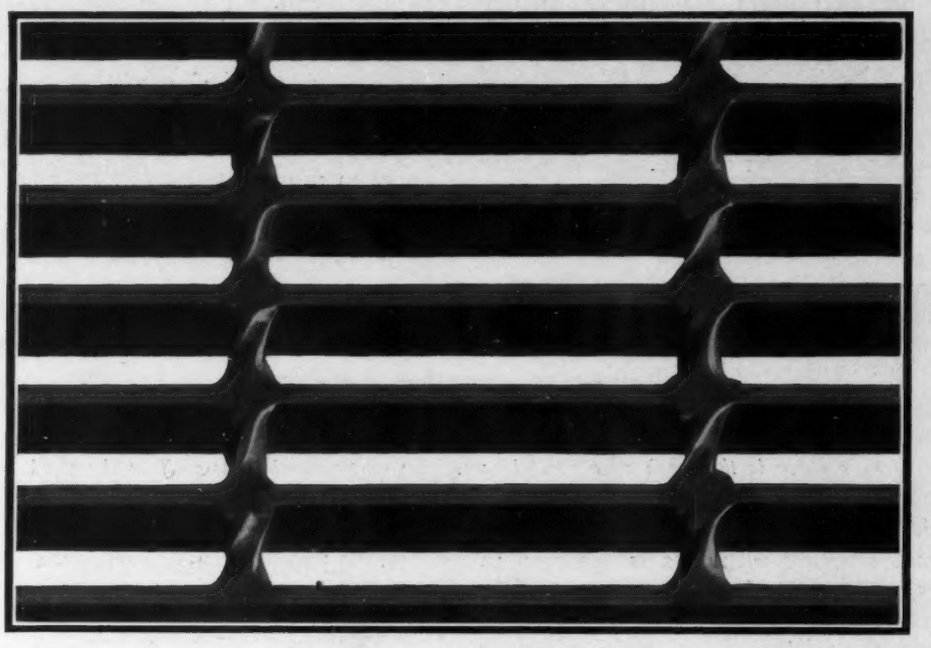


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trend—is it creeping up and how fast, is it drifting down—and adjusts the valve accordingly. In addition, there is an escapement feature that is continually giving a little "kick" up or down, driving it back to the desired point of control, thus preventing it from stabilizing itself on some undesired point; it is this feature which is the distinguishing point of superiority over the so-called air controls. The trend-analyzing instrument can, therefore, make different adjustments for the same point on the scale depending upon whether the temperature is deflecting or returning to the control point, and still be certain of returning to the control point pre-determined.

As mentioned, the real growth in the future will come in automatic control. This year has seen material development in temperature, liquid level, and flow control. Vacuum control of the barometric type for low absolute pressures, independent of atmospheric variation, has been added. These have proven of real values in new vacuum distillation units. The next year will see real achievement in blending these controls, synchronizing them to give an even more satisfactory result.

*—Before meeting of the Manufacturers' Committee of the Western Petroleum Refiners Association, Tulsa, Oklahoma, October 29, 1929.

# Refinery Cost Accounting

By C. E. VOTRAIN
*Barnsdall Refineries, Inc.*

*This paper is the work of a special committee on accounting, as well as the work of accountants of the petroleum industry*

THE following "Classification of Accounts" for skimming and cracking refineries is designed to segregate operating costs by departments and in sufficient detail to reflect a true picture of actual operations. Statements prepared therefrom, while reflecting actual operating conditions, will not be in so much detail as to make them hard to interpret.

Unusual operating conditions are made to stand out in separate accounts or by a comparison of monthly charges to the various accounts. A separate detailed analysis of any account disclosing an unusual condition can be made to determine the cause.

"Instructions" following "Classification of Accounts" gives a brief explanation of the nature of charges to each account where the account name is not self-explanatory.

The "Skeleton Form" presented for computing "Cost of Producing Gasoline" followed by a brief explanation of its use, provides for the inclusion of refinery costs of every nature. Regardless of the method used in computing cost of gasoline it is essential to include all refinery costs if anything approximating actual cost of production is ascertained. Gasoline and other refined products may be offered for sale at what appears to be a reasonable profit based on incomplete cost figures when in reality the selling price includes little or no profit and in some instances will be below actual cost of production.

### Classification of Accounts for Skimming and Cracking Refineries

#### Department Divisions

10—Operating Departments:
- 11. Crude oil stilling—shell stills.
- 12. Crude oil stilling—pipe stills.
- 13. Cracking plant stilling.
- 14. Gasoline vapor treating.
- 15. Re-run stilling.
- 16. Light oil agitators (batch.)
- 17. Continuous treaters.
- 18. Gas plant—still gases.
- 19. Tank yard—skimming plant.
- 20. Tank yard—cracking plant.

30—Utility Departments (For re-distribution):
- 31. Water supply.
- 32. Steam plant.
- 33. Electric supply.
- 34. Compressed air.
- 35. Main pump house.
- 36. Laboratory.
- 37. Trucks.

40—General Departments:
- 41. Refinery office.
- 42. Plant general.
- 43. Loading and shipping.
- 44. Fire protection.
- 45. Material warehouse overhead.
- 46. Machine shop and mechanical overhead.
- 47. Material reclamation.

### Classification of Accounts for Skimming and Cracking Refineries

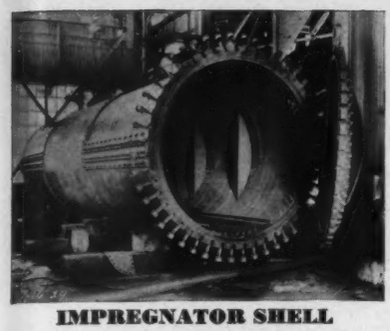
#### Department Subdivisions and Accounts

(A) Labor:
- 1. Operating labor.
- 2. Cleaning expense (labor and material.)
- 3. Unclassified labor.
- 4. Clerical expense.

(B) Supervision:
- 1. Direct supervision (salary and expense.)
- 2. Indirect supervision (salary and expense.)

(C) Repairs and Maintenance:

# Oil Refining Equipment



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**ANGLE BENDING**

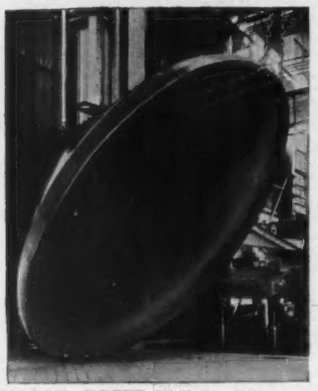
**STILL BOTTOMS**

**FABRICATED PLATE WORK**

**SPECIAL MACHINERY**

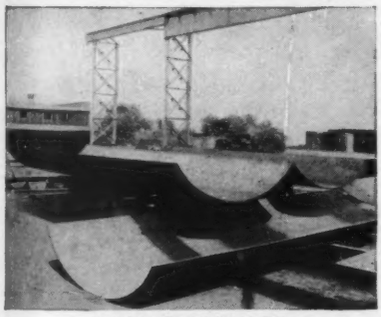
*Estimates on Request*

HIGH PRESSURE HEAT EXCHANGER



SPECIAL CONE (15 ft. diameter)

SPHERICAL HEAD (15ft. diameter)



STILL BOTTOMS

SPECIAL HEAVY TANKS

# PROCEEDINGS OF WESTERN PETROLEUM REFINERS' ASSOCIATION

1. Ordinary repairs and maintenance (labor and material.)
2. Unusual repairs and replacements (labor and material.)
3. Changing equipment and dismantling.

(D) Material Supplies:

1. Miscellaneous operating supplies.
2. Stationary and printed forms.
3. Fuel.
4. Chemicals (separate account for each.)
9. Tools (other accounts as needed.)

(E) Utility Distribution:

1. Water.
2. Steam.
3. Electricity.
4. Air.
5. Main pump house.
6. Laboratory.
7. Trucking.

(F) Sundry Charges:

1. Insurance—workmen's compensation.
2. Insurance—fire, tornado, explosion, etc.
3. Tax—ad valorem.
4. Royalties (separate accounts if needed.)
5. Depreciation of equipment in use.
6. Depreciation of obsolete equipment (plant general only.)
7. Traveling.
8. Telephone and telegraph.
9. Experimental expense.
10. Miscellaneous.

### Instructions Pertaining to Classification of Accounts for Skimming and Cracking Refineries

For account classification purposes skimming and cracking refineries are divided into department divisions under three headings as follows: Operating departments; utility departments; (for re-distribution); general departments.

### Operating Departments

Operating departments for accounting purposes will have to conform to the refinery operations. The attached classification of accounts suggests operating departments that can be adapted to any refinery by adding additional departments or consolidating departments. The suggested operating departments, per classification of accounts, provides for re-run stilling, treating and gas recovery departments to handle products from both crude stills and cracking stills. A separation is made for tank yard expense which may have to be consolidated into one department depending upon the operating conditions of the refinery. If it is desired to obtain costs for skimming operations separate from cracking operations, the expense of operating departments handling products for both can be divided on the basis of the products handled for each division.

### Utility Departments

Utility departments are the departments of the refinery as a whole that serve the operating and general departments and the expense charged to each of the utility departments is distributed on the basis of the service rendered each of the other departments. The suggested utility departments, per classification of accounts, can be revised to conform to the operating conditions of the refinery.

### General Departments

Under the heading of general departments has been included departments that are not classified as direct operating departments or utility departments. The general departments, per classification of accounts, can be adapted to the working conditions of the refinery for which the classification of accounts is used.

Total monthly charges to material warehouse department is to be distributed on a percentage or some other basis to materials requisitioned from the warehouse during the month. Machine shop and mechanical department expense is to be distributed on a percentage or some other basis to job order labor of machine shop and mechanical men. This department is not to be charged with material or labor that can be distributed directly to job orders.

Material reclamation department expense is an offset to the credit for reclaimed material which is taken into the regular refinery warehouse stock. Material, mechanical and reclamation department expense being handled as suggested above will be distributed monthly and the total department expense cleared monthly or at least at the end of each year.

For the purpose of obtaining detail cost classification, the departments are subdivided under the following heads: Labor, supervision, repairs and maintenance, material supplies, utility distribution, sundry charges. Under each of these subdivisions account classifications are provided to furnish detail cost information as follows:

### Labor

Under the classification of labor the chart of accounts shows four subdivisions.

Operating labor is to be charged with the wages of the regular operating or shift men of each department. Charges to this account will not vary from month to month unless rates or number of operating men change.

Cleaning expense is to be charged with labor and material so that the total cost of cleaning can be shown in one amount. This account is to be used in departments where cleaning expense is of sufficient importance to warrant separate classification, such as cracking plant stilling.

Unclassified labor is to be charged with such wages as can not be classified as operating or cleaning labor. This account will seldom be used by operating departments.

Clerical expense is to provide for the salaries of office and clerical men. Operating departments will have use for this account only when a clerk is used within the department to relieve operating men of clerical work.

Any additional accounts can be added under the labor subdivision depending upon the requirements of the

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—A wide range of tower models, all fabricated from standard parts, insure an economical selection for any purpose and accommodation to available space.

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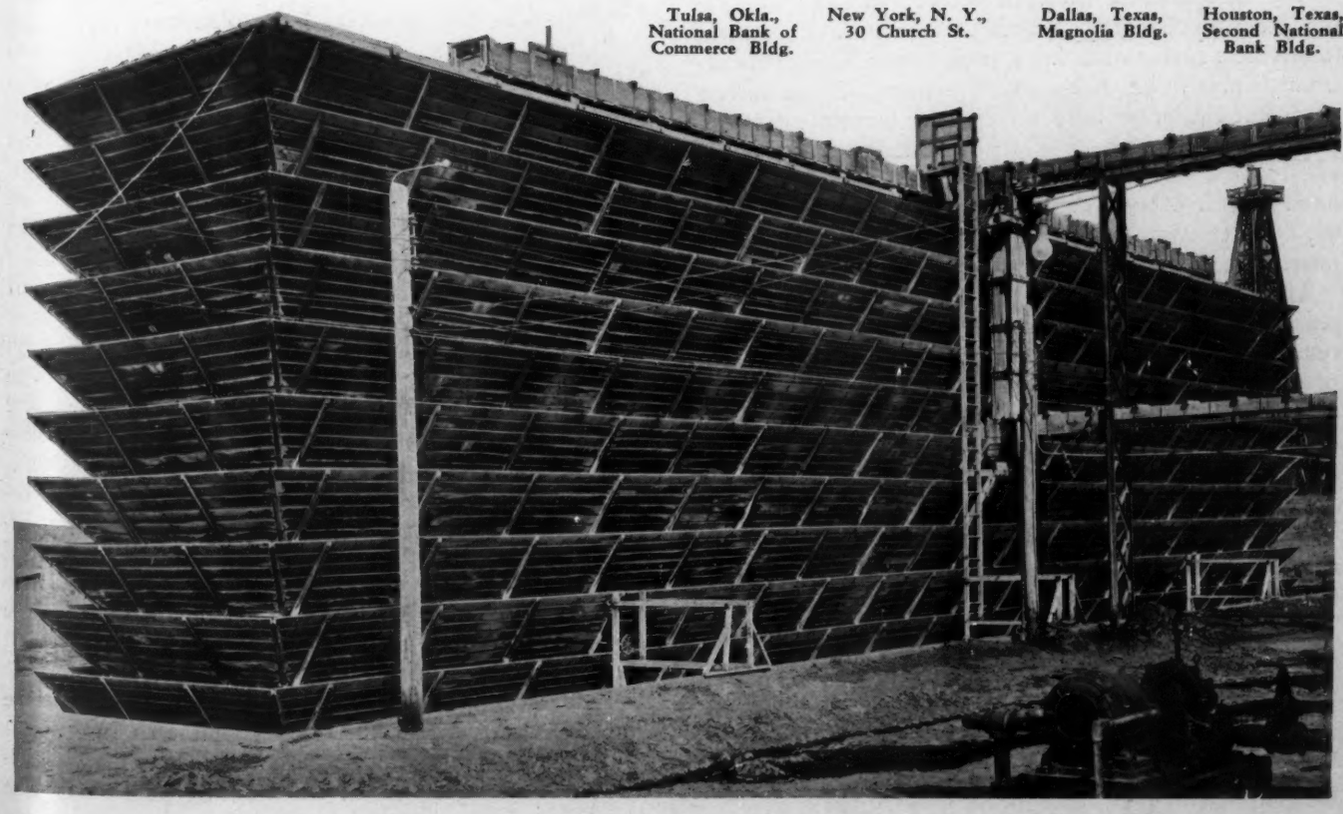
Tulsa, Okla., National Bank of Commerce Bldg. | New York, N. Y., 30 Church St. | Dallas, Texas, Magnolia Bldg. | Houston, Texas, Second National Bank Bldg.



# PROCEEDINGS OF WESTERN PETROLEUM REFINERS' ASSOCIATION

management and operating conditions of the department.

Under the heading of supervision two accounts are provided:

Direct supervision is for the salary and expense of foremen or assistant superintendents who have direct supervision of one or more departments.

Indirect supervision is to be charged with a portion of the salary and expense of superintendents and assistants who have indirect supervision over all departments of the refinery. This expense is prorated on the basis of direct labor charge or some other method which will give a fair distribution of the total salary and expense of superintendents and assistants.

### Repairs and Maintenance

Under the heading of repairs and maintenance three classifications are provided.

Ordinary repairs and maintenance account is to be charged with labor and material for the ordinary repairs and maintenance of equipment in use. Charges to this account under ordinary conditions should vary little from month to month. Variations of any consequence can be explained by detail statements.

Unusual repairs and replacements. This account is to be charged with repair and replacement items of an unusual nature that can be classified as ordinary repairs and maintenance charges and are not handled as offsets to reserve for depreciation. This classification is used for the purpose of distinguishing between the unusual repair and replacement items and charges for ordinary repairs and maintenance.

Changing equipment and dismantling. This account is to be charged with labor for changing equipment within a department that can not be classified as a repair item or changing equipment from one department to another, such as moving a tank, pump, etc. This account is also to be charged with expense of dismantling worn out equipment and for retiring investment equipment that has not been worn out but is of no further use for the department from which it is taken. If a monthly provision is made, as suggested under heading of "depreciation and obsolescence," dismantling expense can be spread evenly throughout the year.

The number of accounts that can be used under repairs and maintenance heading will depend upon the requirements of the management. Accounts can be provided to separate labor from material and in sufficient detail to show repairs to each class of equipment used in each department, if this information is desired. Regardless of the number of accounts used under this heading, it is important that a definite understanding is had as to what constitutes repairs and maintenance charges. If the accounts, as shown in classification of accounts, are used, detail repair and maintenance costs for any equipment in a department could be ascertained from a separate analysis of charges.

### Material Supplies

In the account classification, accounts are suggested under this heading which will vary according to the operations of the departments and the requirements of the management. Accounts can be provided to furnish as much detail as is required. This heading does not provide for raw material charges, such as crude oil, casinghead gasoline for blending purposes, packages, etc., but it does provide for oils used as supplies, such as lubricating oils, absorption oils, etc., and all other materials used as supplies that are not a part of the finished product.

### Utility Distribution

Under this heading accounts corresponding with the utility departments are provided. These accounts are to be charged with the department's portion of the distributed expense of utility departments. This distribution is made on meter readings, time basis, or some other method to reflect as near as possible the actual services rendered to each department.

### Sundry Charges

Under the heading of sundry charges accounts that can not be properly classified under the heading of any of the other subdivisions are provided for. The accounts, shown under this division in the classification of accounts, can be revised to provide as much detail information as required.

"Depreciation of equipment in use" is to be charged with normal depreciation of investment equipment actually in use in each department of the refinery.

"Depreciation of obsolete equipment" is to be charged with amounts written off to relieve "investment" of equipment which has been discarded before being fully depreciated because of being replaced by more efficient equipment. This account is considered as a "plant general" item only and is not necessary if a "reserve for obsolescence" has been provided for.

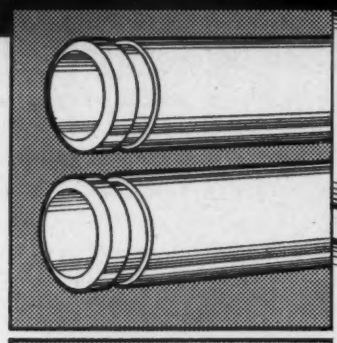
### Depreciation and Obsolescence

Refinery costs should include not only labor and material charges, but a cost for the use of permanent equipment representing the refinery investment. This cost, charged as depreciation, should take into consideration the estimated life of the equipment used, together with the salvage value at the time it is abandoned. The use of any piece of equipment costs just as much as the original installation plus the expense of dismantling when it is removed less the salvaged value. Rates of depreciation should be determined from past experience and revised from time to time as required. In addition to the charge to expense for depreciation provision can be made for the expense of dismantling investment equipment when it is of no further use, also for obsolescence if the equipment is dismantled before being completely worn out and depreciated. By providing a reserve for obsolescence and expense of dismantling investment equipment costs can be more evenly spread over the life of the equipment and eliminate the necessity of adding large amounts to the costs in any one period.

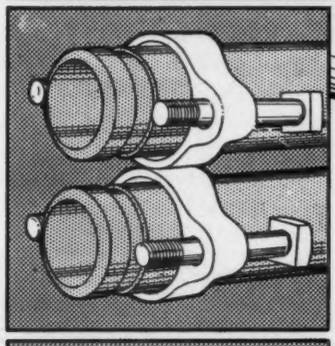
### Investment Record

It is essential that a complete investment record be kept for refineries which should classify investment equipment by departments to correspond with classification of accounts for cost accounting purposes. The

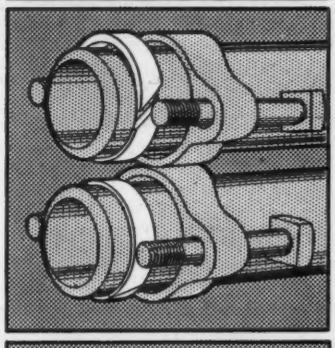
# BOLTED ON



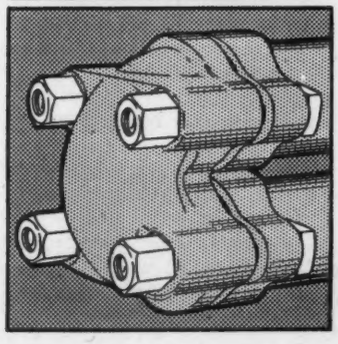
*A pair of tubes to be connected*



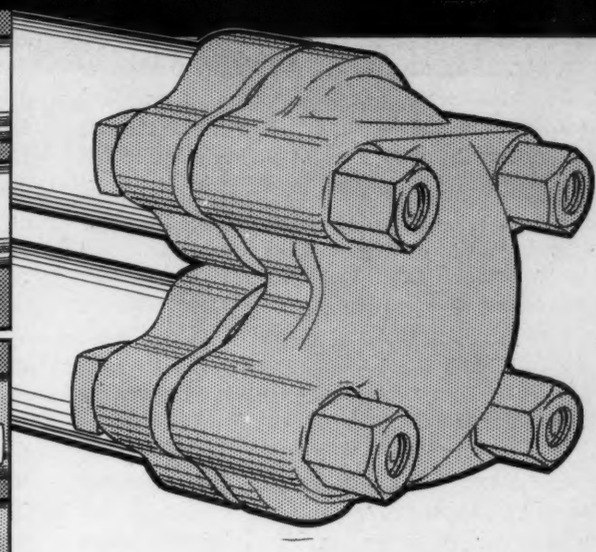
*Followers slipped over the tube ends*



*Split keys snapped into the grooves*



*Return bend bolted in place*



# SECO RETURN BENDS FOR ALL PIPE STILLS

Seco Return Bends are locked in place by simply tightening four nuts. And they can be removed just as quickly. Hence, they afford a saving in installation costs, as well as time off stream when tube replacement is necessary.

Perfect stream-line construction effects material savings in pump steam, so that in operating costs, Seco Return Bends pay daily dividends.

These and five other important advantages make Seco Return Bends the most satisfactory fittings for you to use. Complete information on request without obligation.

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# PROCEEDINGS OF WESTERN PETROLEUM REFINERS' ASSOCIATION

investment record should show in detail the cost of each piece of equipment, together with the amount written off as depreciation. Cost and net value of equipment for each department as shown by the investment record will serve as a basis for distributing depreciation, insurance, taxes, etc. Investment records should be kept up to date at all times and all equipment dismantled written off so that the amount charged to depreciation will represent depreciation on equipment actually in use for each department. The use of investment material transfers covering the movement of any equipment which has originally been charged into investment has been found to work satisfactorily when used in connection with a job order system. The method used to keep the investment records up to date will have to be adapted to the operating conditions of the refinery.

Method of determining cost of producing gasoline from skimming and cracking plant operations per skeleton form of statement as shown above is based on the theory that the refinery as a whole is operated for the main purpose of producing gasoline from crude oil. All other products produced from crude oil by skimming and cracking plants are treated as by-products and deducted from the total crude oil and manufacturing cost at the net value received from their sale.

Skimming and cracking plant operations are taken as a whole to avoid complications that might arise due to distribution of certain departmental expense. All refinery expense is included in determining the cost of gasoline produced, excepting loading and shipping department expense and depreciation of obsolete equipment. Loading and shipping expense is considered as a handling cost of the finished product and is included in the summary to arrive at the cost of gasoline leaving refinery. Depreciation of obsolete equipment is excluded so that the cost of producing gasoline will be the operating cost and maintenance of equipment actually in use. If it is desired to ascertain the cost of gasoline produced, including depreciation of all equipment, whether in use or not, the amount deducted from manufacturing costs for depreciation of obsolete equipment, per skeleton statement, can be added to "per barrel" and "per gallon" costs.

The ultimate field method, providing for the elimination of average treating losses from unfinished products, is used in determining the number of gallons of by-products produced. Net realization from by-products is determined by deducting from the billing price the per gallon, shipping, selling and administration costs of total gallons produced. This net realization being deducted from the total crude and manufacturing costs leaves the net cost of gasoline produced from crude oil. To this is added cost of natural gasoline used in blending for total cost of finished gasoline produced.

**COST OF PRODUCING GASOLINE FROM SKIMMING AND CRACKING OPERATIONS**
**MONTH OF.....**

| Bbls. | | Unit value | | Amount | |
|---|---|---|---|---|---|
| | Raw product cost: | | | | |
| ..... | Crude Oil | ..... | | ..... | |
| | Pipage on crude oil | ..... | | ..... | ..... |
| | Manufacturing costs: | | | | |
| | Skimming plant costs | | | ..... | |
| | Cracking plant costs | | | ..... | |
| | Office and general dept. costs | | ..... | | |
| | Less depreciation obsolete equipment | | ..... | ..... | ..... |
| | Total crude oil and mfg. cost | | | | ..... |
| Gals. | Deduct: Realizable value of by-products: | | | | |
| ..... | Kerosene (billing price) | ..... | ..... | | |
| ..... | Gas oil (billing price) | ..... | ..... | | |
| ..... | Fuel oil (billing price) | ..... | ..... | | |
| ..... | Fuel gases | ..... | ..... | ..... | |
| ..... | Less: Pro rata marketing expenses: | | | | |
| | Shipping | ..... | ..... | | |
| | Selling | ..... | ..... | | |
| | Administration | ..... | ..... | | |
| | Net realization from by-products | | | | ..... |
| | Net cost of gasoline from crude oil | | | | ..... |
| | Add: | | | | |
| | Natural gasoline used in blending | | | ..... | |
| | Freight on natural gasoline | | | ..... | ..... |
| | Cost of gasoline produced | | | | ..... |

SUMMARY

| Gals. | | Per bbl. | Per gal. |
|---|---|---|---|
| ..... | Net cost of gasoline from crude oil | ..... | ..... |
| ..... | Cost of natural gasoline for blending | ..... | ..... |
| ..... | Gasoline production costs | ..... | ..... |
| | Add: | | |
| | Pro rata shipping expense | ..... | ..... |
| | Cost of gasoline leaving refinery | ..... | ..... |
| ..... | Depreciation on obsolete equipment | ..... | ..... |

## Sir Henri Deterding to Appear on Institute Program

The tenth annual meeting of the American Petroleum Institute will be held at Chicago in the Stevens Hotel, December 3, 4 and 5.

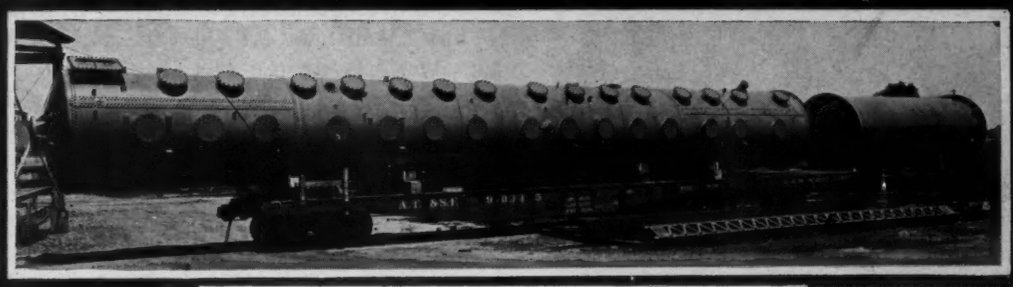
That the international aspect of the petroleum industry will have major consideration at the annual meeting was assured through the announcement that Sir Henri Deterding, managing director of the Royal Dutch Shell companies, will appear on the program. He will speak the afternoon of December 3 and his subject will be "Common Sense in the Oil Industry."

At the annual meeting in 1928 Sir John Cadman, chairman of the board of the Anglo Persian Oil Company, was the principal speaker. Further information on Sir Henri Deterding was given in the Institute's announcement, as follows:

"Sir Henri visited this country in March of this year, attending a meeting of the Institute's Board of Directors at which he pledged the cooperation of the Royal Dutch Shell interests in a contemplated agreement between oil producers to hold the 1929 output to the level of 1928. The plan was recommended by the Institute's committee on world production and consumption of petroleum and its products after a survey of the situation in the western hemisphere had disclosed a state of overproduction of oil and was accepted by the directors.

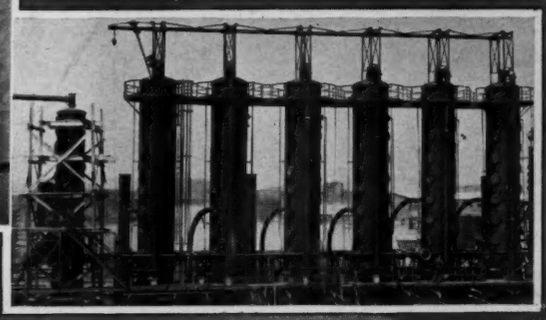
"The plan never became effective, however. The Federal Oil Conservation Board refused to approve it after the United States Attorney General had ruled that body lacked authority. The Institute directors thereupon ordered that it be held in abeyance and announced the Institute would cooperate with the board in any further efforts toward oil conservation."

# PACING PROGRESS!



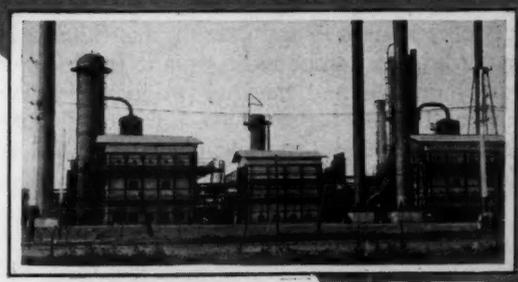
Whether it's a Bubble Tower,

—a continuous Treating Plant,



—a re-modeled Shell Still Battery

WINKLER-KOCH continues to keep refiners throughout the nation a step ahead in the modern trend of refining. Let them handle your problems. A letter, or wire, will bring complete information.



—or a complete refinery that's needed

## The WINKLER-KOCH ENGINEERING Co.

*Consulting and Construction Engineers*

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# DEALING IN PERSONALITIES

By GEORGE REID

*G. T. Yost, resident chemist, Pure Oil Company, Marcus Hook, Pennsylvania*

PURE Oil Company at Marcus Hook does about everything with a refinery that can be done. Many grades of gasoline come from its skimming plant which processes both Pennsylvania crude and crude delivered to its terminal in tankers from various sources. All grades of lubricating oils and many industrial lubricants are produced. Its compounding plant produces a complete line of greases and kindred products. Cross cracking units and Gyro vapor phase units contribute their premium grades of motor fuels. Gyro vapor phase gases are delivered through a metering station to the U. G. I. at Philadelphia which are completely and continuously analyzed before delivery. In addition, at Marcus Hook there is a complete paint manufacturing department. Further, there is a complete plant for the manufacture of hand, laundry, and automobile soaps, as well as some trick and fancy soaps the writer knows nothing about.

With all this to look after from the laboratory end of the business we wonder how G. T. Yost, resident chemist in the picture, keeps on smiling. He says he has but little to do with the fire hose just behind him—for a chemist's duties have got to end somewhere. The large building behind him is the new filter plant. Yost has perfected an operating form which shows the conditions of all filters every hour, that gives information long needed about a filter plant.

Some years ago when Yost was at Pure Oil Company's Smiths Bluff refinery and George Reid was chief chemist at the American Refining Company, Wichita Falls, Yost spent a week in the latter's laboratory trying to keep the erstwhile American chemist from shipping fuel oil to Pure Oil Company with too much sulphur content. Yost admits he "had a time." However, we'll say here that Yost can run more sulphur analyses at one time and use more lab. equipment at once, and put it in more places—and at the same time explode the Calorimeter oftener and with better effect, than any chemist we ever had the pleasure of working with. And, despite the fact that the lab. in question, although housing seven workers, was not big enough when Yost got going good, his visit was enjoyed so much that we tried to get him back through the use of subterfuge and sent him fuel oil off viscosity test. Evidently he doted on sulphur, for viscosity never brought him back. Five years later we take his picture and offer it as evidence that a chemist can be a regular fellow over quite a period of time.

---

CRUDE oil for processing at the Louisville Refining Company, Louisville, Kentucky, comes from the western Kentucky fields, mostly from the Weller pool in Ohio County. It is delivered from Owensboro, on the Ohio River, to the refinery in barges; coming a distance of 132 miles. Three of these barges of 5,000 barrels capacity each make an average of nine trips per month. At the refinery the oil is unloaded by centrifugal pumps at the rate of 1,000 barrels per hour.

The man in the picture with the white shirt is G. C. Hatfield, assistant to C. A. Jouett, general superintendent of the refinery. Hatfield is in charge of the skimming plant department of the refinery and is caught here in the act of supervising the unloading of three crude oil barges. "G. C." has been on the job at Louisville since the plant was first started five years ago. He came with the old company to aid in the construction and operation of the original Dubbs units,—since the plant was first built for cracking only. The 3,500 barrel skimming plant on the same site was a later development. It was reconditioned and placed in operation by the present owners in April of 1928.

Prior to the five years with this plant, Hatfield was with the old Sterling Refining Company in Kansas and

*G. C. Hatfield, Louisville Refining Company, in charge of the skimming plant, supervising the unloading of crude oil from barges on the Ohio River*

# EQUIPMENT
## back of good service at *Wyatt's*

AUTOMATIC
ARC
WELDER

Among the many modern machines at the new eleven acre plant of the Wyatt Metal & Boiler Works at Houston is a 36-foot Automatic Seam Welder, designed and built by the General Electric Company.

It produces a weld that has a tensile strength equal to that of the actual parent metal . . . and because of the fact that it is an automatic welder gives uniform strength throughout.

WYATT METAL & BOILER WORKS
DALLAS *Capital $1,000.000* HOUSTON

Wyatt's **WYATT**
**METAL & BOILER WORKS**

the Derby Oil Company. Vacation periods find him driving back to southern Kansas to visit with friends in the refining industry in that district.

Visits to the plant of this company at Louisville are of interest and are pleasant experiences because its operators are constantly modifying and improving, bettering economy, and getting increased fficiency — and they always make the visitor feel perfectly at home.

---

IT seems a book was once written about Three Men and a Dog. There is no doubt but that one could be written about the principals in the photo below. Since there is not room here, however, we will introduce them from left to right:

E. A. Anderson, is superintendent of the Elk Refining Company plant at Falling Rock, West Virginia, 17 miles north of Charleston. He has operated this plant from its inception 15 years ago and seen it develop into one of the most modern refineries in the Eastern district. Since his home is on the plant site we might say he has lived with it for 15 years.

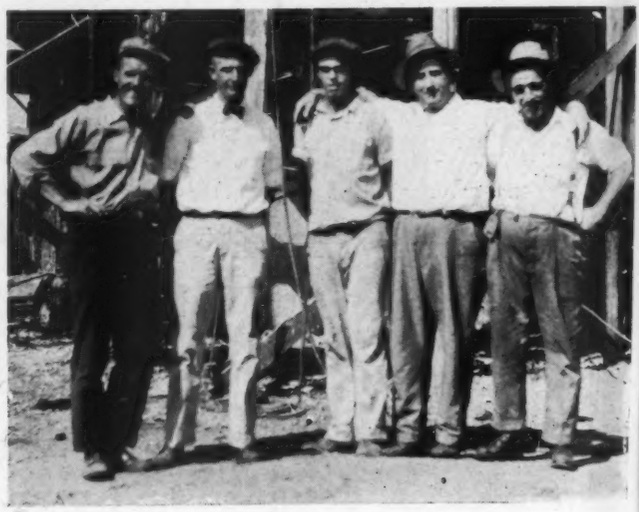
C. J. Hesch, chief chemist for the past five years at this refinery looks after the production of a full line of the usual refinery products and in addition fathers the preparation of a wide variety of special products including rubber solvents and close cut naphthas. Incidentally three overhead streams of pressable wax distillate are distilled from shell stills in the operation of this plant.

*Three men and a dog, superintendent, chemist, and manager of the Elk Refining Company at Falling Rock, West Virginia, 17 miles north of Charleston*

R. D. Lowe, "R. D. the world over," as he invariably introduces himself, has been manager of the Elk Refining Company for several years. "R. D." is also president of the West Virginia Oil Marketers Association which holds its convention in Charleston every June. R. D. Lowe and George Reid claim to hold the worlds championship for close contact in traffic jam driving. Without a single interception by any one of New York's 20,000 taxis the two drove into New York City, bumper to bumper, up Broadway to their hotel, during the 8 p. m. theater rush hour. They insist that it can't be done again.

Concensus of opinion is to the effect that the Boston Bull in the photo knows more about having its picture taken than all three of the men. Certainly the dog is pretty. Whether the men are or not is a matter of personal opinion.

Now comes the beautiful secretary of the Gulf Publishing Company's Pittsburgh office, where this is written, to say that we're all wet about the name of the story mentioned being "Three Men and a Dog," and that the title was "Two Men and a Maid." Even so, we still insist that the dog is pretty, and a book could be written about the three men in the photo.

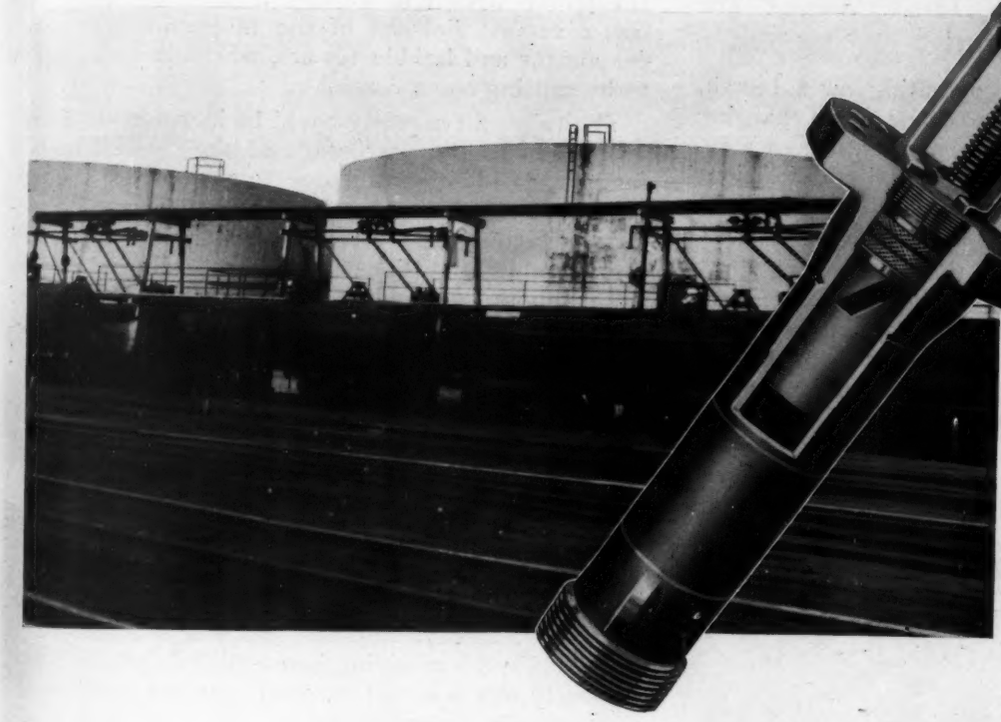


*Four of these men have "been through it all" in the perfection of Indian Refining Company's Grover's Process for the manufacture of wax free lubricants*

TWO years of hard work, constructing, operating, modifying, reconstructing and finally perfecting the new Gover's Process for the manufacture of lubricating oils at the Indian Refining Company's Lawrenceville, Illinois, plant seems not to have injured physique nor ruined good dispositions of the men shown in the accompanying picture. These gentlemen have "been through it all," for the Gover's Process was taken from the glassware of the laboratory and converted to commercial scale without the delay of the usual intermediate stages.

John Anderson, at the extreme left, is of the engineering department, where things have also been humming in a mad fashion for many months. Next is Henry Bonham, who is in charge of the two vacuum installations, the skimming plant tube stills and the gasoline recovery plant. The youngster in the middle was of the insulating force and left to return to college without leaving his name where the writer could find

# GAS lost at Loading Racks *is* NEVER RECOVERED



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it. The fourth gentleman is P. W. Wells, superintendent of the Indian Refining Company plant,—12,000 barrels, skimming; 13 cracking units, and two types of lubes plants. He has seen so much construction in recent years at this plant he will die of ennui if it ever stops,—which, very likely, will not happen. Then, Smith Engle, who is an operator on the vacuum units recently perfected.

The men are standing near the base of a recently completed preheater unit which is unique in the refining industry as it incorporates some features of design not previously employed in refining work.

## An Engineering Fee That Won't Be Collected

A CERTAIN refinery, operating on a certain unpopular sulphurous crude was charging oil to tube stills and vaporizor through a series of very efficient interchangers where sufficient heat was picked up to effect the distillation of a light gasoline fraction.

The oil was passing from the exchangers, however, direct to the tube still to be heated to sufficient temperature to vaporize all fractions down to and including the gas oil. From the evaporator or separator the vapors passed into a series of bubble towers where the gasoline, kerosene, and gaso oil were rectified in the usual manner. The tube still was operating somewhat below its obvious capacity and corrosion of condenser equipment was worrying plant management. On top of it all sales were demanding higher crude through-put.

In discussion, management figured that cost of installation of a primary evaporator and small tower to remove light gasoline stream from the crude after preheat in exchanges, and cost of additional pumping of crude to pipe still, would be offset by saving in steam, equipment, and pumping, by continuing operations as outlined above.

Then there came some figuring. Ammonia neutralizing of a small cut of lighter and more corrosive gasoline vapors would be cheaper than neutralizing about the same amount of corrosive agent diluted in the larger stream of vapors, and would keep this corrosive material out of the tube still, secondary evaporator and bubble towers, where it was certain to be causing some corrosion.

The tube still capacity could be increased in direct proportion to the percentage of the crude distilled in light gasoline stream due to preheat in the exchangers, or around 15 to 18 per cent. Present fractionating equipment would suffice for the increased crude throughput since it, too, was relieved of the light vapors. In addition to increased capacity of the plant, the primary equipment should be materially lengthened in its service life, since it would be rid of the corrosive agent.

Further savings developed when the laboratory found that the light gasoline fraction treated to "sweet" with a simple caustic wash. The second gasoline stream required more thorough chemical refining. Both cuts had been treated together under the previous operating scheme. The second cut of gasoline now requires no ammonia neutralization. The light stream requires much less ammonia to show up in the receiving house slightly alkaline than formerly was use, and its condenser has outlived the former coils several times.

To the progressive designing engineer it is incredible that plants will operate without taking advantage of waste heat wherever available or possible to utilize. Yet they do so.

The revamped plant now can charge considerably more crude through its tube still, fractionate the gasoline more efficiently, and it does secure a little higher yield of gasoline. The installation of a primary evaporator, a small tower, a condenser and a second hot oil type crude pump has effected this improvement in efficiency. Treating costs are slightly lower, as are vapor stream neutralization costs. The new equipment will pay its way many times over. No additional labor is required, and fortunately the plant is already equipped with sufficient tankage and transfer lines, etc., to handle the lighter fraction of gasoline. The refinery now has two grades of gasoline, which, with natural gasoline, are blended in varying proportions to provide a number of grades of motor fuel if such are required.

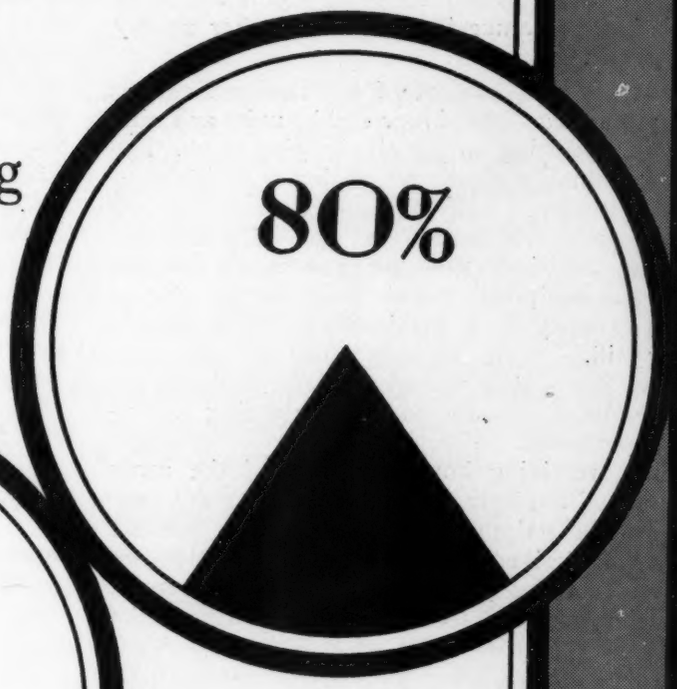
As we said at the beginning, "A certain refinery operating on a certain unpopular sulphurous crude," probably owes a certain oil magazine representative a certain consultant engineering fee; which we are certain we won't get.

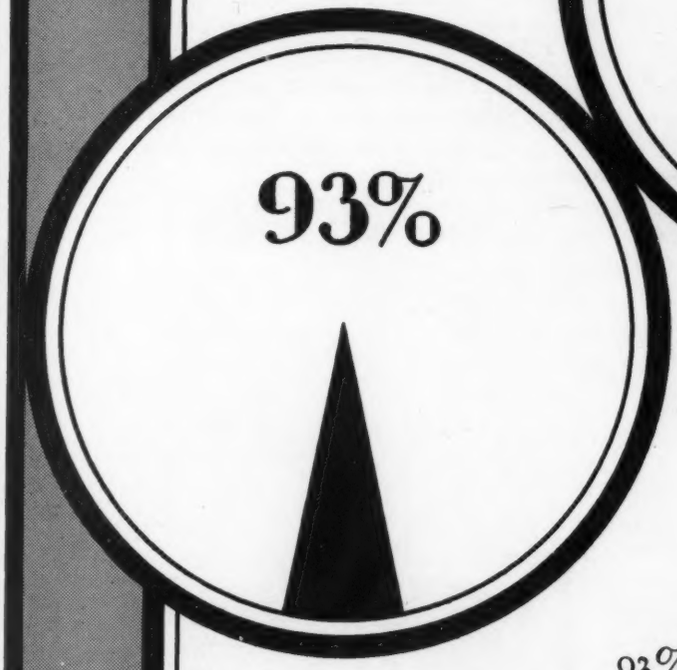
# 32

Companies (including their subsidiaries) operate

80%

of the refining capacity of the country




OF THESE

32

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# Refinery Gases Marketed As Domestic Fuel

FIXED gases from the cracking plant operation, and uncondensible gases from the crude distillation plant and light oil tanks, are processed through a large and modern gasoline recovery plant, which is also designed for the chemical removal of all hydrogen sulphide from the vapors, and are then marketed by the Indian Refining Company in its home city of Lawrenceville and three other nearby Illinois towns.

The cracking department of the Indian Refining Company plant consists of four Dubbs units and nine Cross units operating on gas oil charging stock. The tube still skimming plant was originally designed to process 5000 barrels daily through each of the two stills. Recently this department has been enlarged through the addition of larger and more efficient fractionating equipment which has effected an increase in capacity to a maximum of 9000 barrels daily per still.

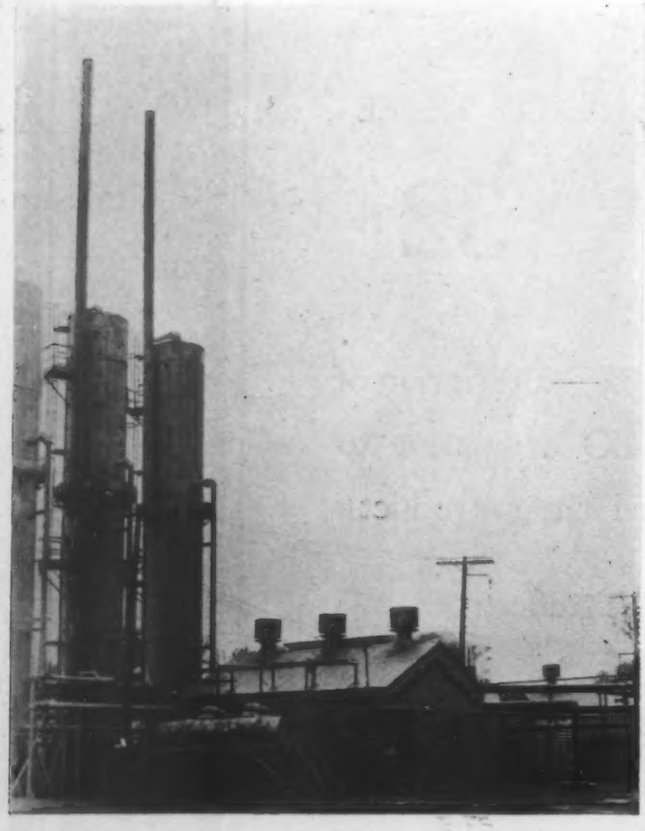
All fixed gases from the accumulator tanks at the cracking units are conducted to the cleaning and recovery department. Also all vapors from the skimming plant receiving houses, certain of the rerun still units, and the light oil run down tanks are purified and then stripped of their gasoline content. Those gases derived from the cracking operation come over to the scrubbing and gasoline extraction plant under pressure from the accumulator tanks. Skimming plant vapors are drawn to the extraction plant by means of a Roots exhauster which pulls a slight vacuum, about one inch, on the various gas sources.

Gases derived from the skimming plant where Illinois crude is processed bear sufficient quantity of hydrogen sulphide to necessitate purification. Contrary to expectations, the gases from the cracking department require less treatment or purification than do the skimming plant vapors. Since the gas is finally marketed for domestic heating purposes, it is necessary that it meet certain sulphur content specifications. A large part of the gas production is utilized at the plant as fuel for refinery operations and in the laboratory.

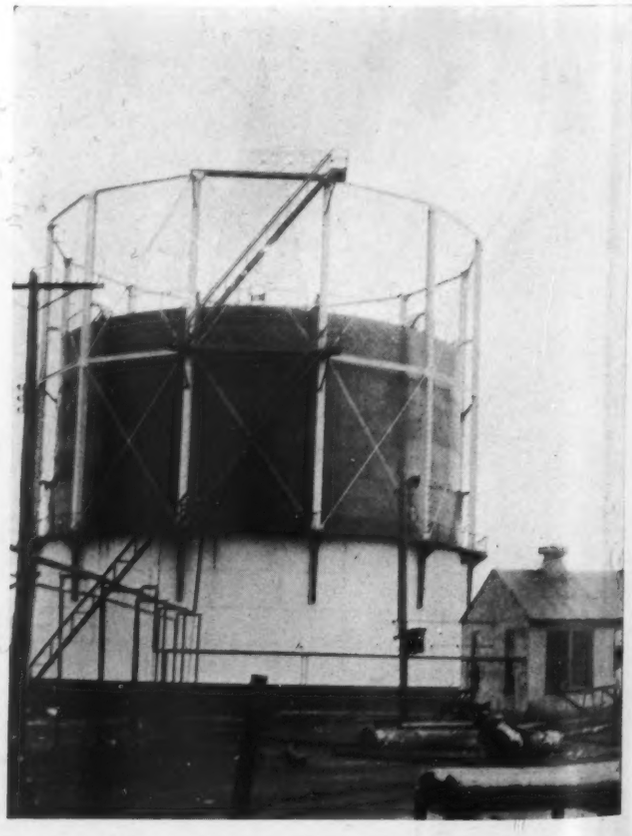
### HYDROGEN SULPHIDE REMOVAL

The purification of the refinery and cracking plant gases is done in a series of three large towers, called scrubbers, where soda ash solution is employed to remove the hydrogen sulphide. In the general view of the recovery and purifying plant accompanying this article the three large scrubbers, control house, and part of the absorption plant are shown. Two of the scrubbers are used in the purification of refinery gases, and the remaining scrubber is used to treat cracking plant gases.

These towers are built in two sections. Gas enters the bottom of the upper section and flows up-



*Gases are purified with soda ash solution in three towers to the right of the picture. Gasoline recovery plant equipment in the background*



*Gas holder at Indian Refining Company's refinery at Lawrenceville, Illinois. Fuel for plant operations and for domestic heating in four towns is distributed from this holder*

# SEAMLESS ENDURO KA2

## —*Easily Welded*

Cross section of Seamless Enduro KA2 Pipe flash welded.

Section of pipe with weld material built up and machined for one thread union.

ANOTHER outstanding advantage in the use of Seamless Enduro KA2 in the fabrication of coils and for pipe lines subject to high temperatures or excessive corrosion is the ease with which this improved chrome-nickel alloy can be welded.

Welding Seamless pipe of Enduro KA2 is easily accomplished with the arc, either direct or alternating current,—and by either flash welding or gas welding.

Tough, ductile welds are obtained due to the fact that Enduro KA2 has no capacity for hardening except by cold working.

In addition, Seamless pipe of Enduro KA2 resists a wider range of corrosive media than any other comparable alloy, withstands high temperatures and pressures, and has working properties similar to those of ordinary steel.

If you will acquaint us with your pipe problems, particularly those which now require the use of fragile non-corrosive materials, our engineering department will be glad to advise you relative to the suitability of Seamless Enduro KA2.

*Enduro KA2, manufactured by Central Alloy Steel Corporation, is fabricated into seamless tubes and pipe by*

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ward through tightly packed wood grids in countercurrent flow to the descending soda ash solution of about 10 gravity Baume. The hydrogen sulphide is removed by the soda ash solution. This solution accumulates at the bottom of the upper section to flow out of the tower and down into a spider spray device placed at the top of the bottom compartment of the tower.

This bottom section is also packed with wood grids. Sturtevant fans are provided for each tower which blow a blast of air in the bottom of the lower compartment of these towers. As the soda ash solution enters the section through the spider and duct it is blown free of the sulphur compounds by the blast of fresh air. The air passes out of the compartment through a circular outlet at the top, and is dissipated into the atmosphere through the tall stacks reaching above the top of the scrubber towers.

In this system the soda ash solution extracts the hydrogen sulphide from the gas, and in passing through the lower compartment is itself purified by the air blast, all in the same continuous flow through the single piece of apparatus. As the solution accumulates in the bottom compartment it overflows into one of three small solution-mixing tanks located at the side of the control house. Additional soda ash is added at this point as needed, with solution being speeded by means of a rotating mechanical mixing device.

While the gases derived from the cracking department are passed through but one of the soda ash scrubbers to effect sufficient removal of hydrogen sulphide to meet specifications, it is necessary to take the vapors from the skimming plant operation through two of the scrubbers in series, giving it a second wash with the soda ash solution.

Both types of gases are conducted from the purifyers to a common header line and passed through the absorption gasoline plant. Since the gases from the cracking units arrive at the header at about 24 pounds pressure, the skimming plant gases are first compressed to the same pressure by a Worthington machine. The absorption plant, which is a complete Newton installation, operates at 24 pounds, and extracts the gasoline using a 42 A. P. I. gravity naphtha as the absorbing medium.

Gases leaving the absorbers are conducted over a large gas holder, having a capacity of 200,000 cubic feet. From this point the gas is distributed to consuming points about the plant and to the nearby towns of Lawrenceville, Bridgeport, Olney and Sumner, Illinois. Gasoline recovered in the absorption plant varies, of course, with the number of cracking units in operation and the volume of crude charged to the stills. Average gasoline production is around 200 barrels daily. The product is taken to continuous treating system and sweetened in the closed circuit and employed for blending motor fuels. The gas which is handled through the gas holder and marketed to the nearby towns has a heating value of 1300 B. T. U. The system of purification, gasoline recovery, and gas storage, is economical of operation and requires but one operator on each eight-hour shift.


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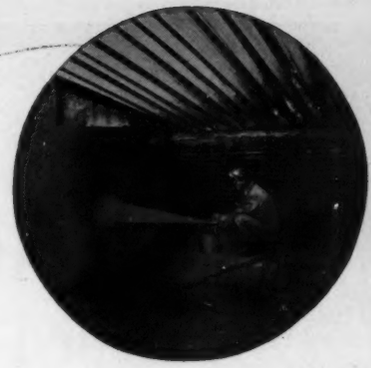

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We have made an intensive study of this problem, and our experiences are available to every refinery. We shall be glad to send complete data and application instructions for this proven mixture, if you will give us an outline of the service conditions pertaining to the equipment under consideration. Write us today.

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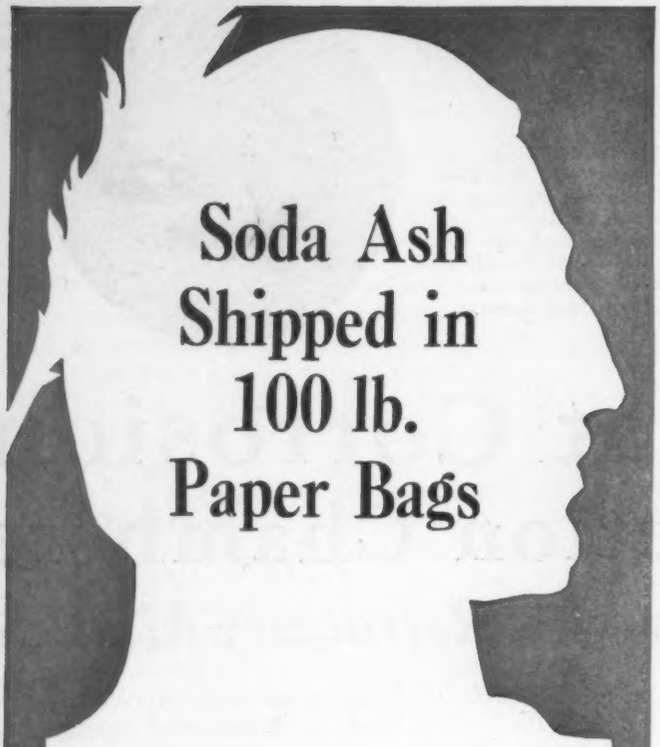

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# REFINERY AND GASOLINE PLANT ACTIVITIES

*New Plants – Construction Notes – Personnel Changes*

## Hanlon-Buchanan, Inc., Formed in Natural Gasoline Industry

Formation of the Hanlon-Buchanan, Incorporated, with headquarters in Tulsa and a terminal and processing plant at Good Hope, Louisiana, was announced in October. The firm became active November 1.

Organizers of the new concern have been identified with the natural gasoline industry for several years. Officials are E. I. Hanlon, chairman of the board; D. E. Buchanan, president; A. F. Wood, vice president; J. H. Boyle, secretary-treasurer; M. F. Waters, director.

The announcement of organization gave the following as the purpose:

"To process natural gasoline for coastwise and export shipment, to utilize the lighter hydrocarbons such as butane and propane along some new lines and to sell the conventional grades of natural gasoline."

The processing plant with a complete terminal at Good Hope will process conventional grades of natural gasoline into a highly volatile, yet stable gasoline, which can be shipped in cargo lots with no more loss than attends the shipping of ordinary motor fuel. The cargoes will be shipped in the coastwise and export trade.

Mr. Buchanan was one of the first men to develop an export market for natural gasoline. He has been an exponent of the idea that the natural gasoline industry must diversify and expand its markets through manufacturing special products. According to his views, since the present natural gasoline market is subject almost entirely to demands for blending natural gasoline and refined products, anything accomplished in diversifying or expanding the demand in other channels will benefit the natural gasoline industry.

The company will use the lighter hydrocarbons such as butane and propane in lines not now common to the industry. In addition to the export and processing activities, the company will market ordinary grades of natural gasoline in tank cars.

A further plan of the concern is to acquire natural gasoline production, which, with purchases from present producers, will supply the material for all these operations.

The general office of the company is at First and Detroit Streets, Tulsa, Oklahoma.

**JAMES L. FARRELL**

James L. Farrell was recently named general superintendent of refineries of the Imperial Refineries, with headquarters at Tulsa. Previously he was with the Producers & Refiners Corporation at Parco, Wyoming. Mr. Farrell is a graduate of the Agricultural and Mechanical College of Texas.

## Hanlon-Waters Company Organized

The Hanlon-Waters Company, Inc., began active operation November 1 at Tulsa as representatives of the Victaulic Company of America, Fisher Governor Company and the Reed Air Filter Company.

E. I. HANLON

M. F. WATERS

D. E. BUCHANAN

J. H. BOYLE

General offices and headquarters were established at First and Detroit Streets.

Officials of the company are E. I. Hanlon, chairman of the board; M. F. Waters, president; D. E. Buchanan, vice president, and J. H. Boyle, secretary-treasurer. The four men are well known to the petroleum industry.

A complete stock of the equipment is being carried in Tulsa, to assure prompt shipment. Other lines are to be added. A new type of oil and gas separator is to be announced soon by the new concern. It will be built on new principles of design and performance.

## Vacuum Interested In Lubrite Company

Through the Vacuum Investing Company the Lubrite Refining Company of St. Louis has joined with the Vacuum Oil Company to form the Lubrite Refining Corporation, which has acquired all the assets of the Lubrite Refining Company.

The new company will continue under the management of the men who formerly controlled it. W. W. Strickler, who was president, has been named chairman of the board. H. T. Ashton has been made president, having been vice-president and general manager. W. H. Ware, formerly in charge of sales, has been made vice-president.

The company has a refining plant at East St. Louis, Illinois, where it has a large bulk plant. The distributing system includes five other bulk plants and more than 200 retail service stations.

## New Company Buys Texas Plant

The Tarrant Petroleum Company, which was organized early in October with a paid in capital stock of $75,000, has purchased the Grand Prairie refinery of the Primtex Refining Company, Dallas, and is conditioning the stills to resume operating on crude to be obtained from the Magnolia Pipe Line Company. The latter has a line that is delivering Oklahoma crude to a plant at Dallas, and only a short extension will be required. The Grand Prairie plant is rated at about 2000 barrels daily. The new owners are blending products, pending completion of the proposed improvements, and will confine its sales to the wholesale market.

Headquarters of the Tarrant Petroleum Company are located in the First National Bank Building, Fort Worth, Texas. The officers are Alex Cobden, president; Jessie Cobden, vice-president and R. J. Cobden, secretary-treas-

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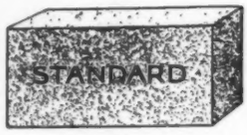
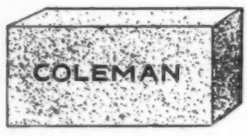



Acme Brick Company, Fort Worth, Texas

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Used by all big producers because of the intensive movements.

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urer. The former has been engaged in the fuel oil business in Fort Worth for many years, operating as the Cobden Fuel Company. John Muense has been retained as plant superintendent by the new owners.

### TO GET PECOS CRUDE

Steady operation of the Big Lake Refining Company's 1000-barrel skimming plant at Big Lake, Texas, is to begin early in November following purchase of a crude supply from the Landreth Production Corporation for one year. Contract has been made for 500 to 1000 barrels daily of Pecos County crude, testing 29-31 gravity, and deliveries to the plant are to be made in tank cars from McCamey, Texas, where the Landreth Production Corporation has installed a 60-car rack and tank farm, with an eight-inch trunk line connecting with the Taylor-Link and Rowan-Tong pools, Pecos County.

### NEW CONTRACT SIGNED

The Shreveport plant of the Louisiana Oil Refining Corporation will continue to operate on West Texas crude from the Hendrick field as result of a contract having been made with the Southern Pipe Line Company for 7000 barrels daily, with provisions made for 10 per cent less or greater shipments daily, for a period of six months beginning November 25, 1929. The Louisiana concern is supplying the bulk of its crude requirements from Hendrick field through a contract with the American Petroleum Company, but this will be completed in November. Hendrick crude is popular with refiners because of the anti-knock qualities in the gasoline manufactured from same, while the crude also supplies a zero cold test fuel oil that commands a premium from Northern consumers.

### CAMDEN PLANT CLOSED

Effective October 1, the Houston Oil Company's refinery at Camden, Arkansas, closed down for an indefinite period. Fifty employes were laid off. Shortage of crude oil was given as the cause of the shut-down which may continue until January 1, according to G. H. Hartung, superintendent.

### OZARK ENLARGING PLANT

Another unit is being added to the plant of the contact acid plant of the Ozark Chemical Company in Tulsa. The new unit, which will cost $200,000, will be in operation by January 1. A vanadium catalyst will be installed.

### NEW WYOMING REFINERY

The new refinery being built by the B. V. Hole interests in the Osage field of Wyoming is already well under way, and should be in operation in 60 days. The plant will have a charging capacity of 500 barrels and will produce light, medium, heavy and extra heavy lubricating oil, and a high grade of airplane oil.

### EARLE F. MOORE DIES

Earle F. Moore, chief operator and field service engineer of the Jenkins Petroleum Process Company, Chicago, died October 9 at Big Spring, Texas, following an emergency operation October 5.

Mr. Moore was 36 years old and had served in the A. E. F. He had received divisional and regimental citations for bravery in action and during his service in France was severely gassed but had recovered.

He had his early training in pressure still work during 11 years with the Standard Oil Company (Indiana) at the Whiting plant. He had been with the Jenkins organization three years. He is survived by his widow and two sons.

---

**H. Englehardt,** superintendent of the Mid-Tex Refining Company's refinery at Midland, Texas, has resigned, and has returned to his former home at Fort Worth. This plant is the first of a trio of portable skimming plants made for the Portable Refining Company, Dallas, by The Graver Corporation, and originally saw service during the banner days of the Wortham field, East Central Texas.

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**Chas. T. Wolverton, Jr.,** manager of the Olney Oil & Refining Company's skimming plant at Olney, Texas, resigned late in September to join the sales and operating staff of the Central-Texas Refining Company at Corsicana, Texas. The latter concern is a subsidiary of the Cranfill-Reynolds Company, and is operating five separate plants in Texas, with a number of bulk and retail stations also.

---

The fall meeting of the California Natural Gasoline Association will be celebrated with a banquet in the Biltmore hotel, Los Angeles, November 14, according to an announcement from H. S. Cole, secretary of the association.

The announced banquet takes place of the regular two-day session, inasmuch as those in charge of the association's affairs decided it would be better to hold the two-day session only once in every two years, rather than yearly.

Further information regarding the banquet may be had from Mr. Cole at 733 Higgins Building, Los Angeles.

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### CAPITAL INCREASED

Dale Oil Refining Company, which operates a 2500 barrel daily capacity refinery at Electra, Texas, has increased its capital stock from $150,000 to $250,000. Dave G. Gray is vice-president and general manager of the company. Crude supply is being obtained on a one year contract from the W. T. Waggoner Estate's holdings in Wilbarger County.

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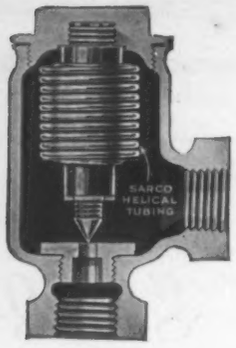


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### LARGE LABORATORY STILL BUILT FOR EXPERIMENTATION

A large laboratory batch still, designed by chemists of the San Francisco laboratories of the United States Bureau of Mines, is being constructed at the bureau's San Francisco field office. This apparatus when finished will be the finest and latest type of its kind in operation. It will be automatically controlled and the tower will be practically adiabatic, which should result in the best possible fractionation.

A combination manometer and vacuum regulator has been designed, constructed and tested which will make it possible to control the vacuum in the fractionation system to within a variation of 2 microns. This, so far as is known, is the most sensitive of any regulator that has heretofore been constructed. When the construction work has been completed, exhaustive tests will be made on crude oil from various California fields.

### DYNAMOMETER TEST ON SHALE OIL GASOLINE

A dynamometer test on refined shale oil gasoline was recently made by the United States Bureau of Mines in co-operation with the State of Colorado, at the University of Colorado. The gasoline used in this experiment was refined by low temperature sulphuric acid treatment. The analysis of the treated gasoline was as follows: A. P. I. gravity, 58; doctor test, sweet; color, 25 Saybolt; sulphur, 0.111 per cent.; Engler distillation, satisfactory; unsaturation, about 20 per cent. The dynamometer was a six-cylinder engine used by the university in the automobile testing laboratory. After running the engine on a standard gasoline to insure constant operating conditions, a series of tests was made on the shale gasoline, and the electrical horsepower developed was 30.43 which was an increase of 4.03 per cent. in horsepower over the petroleum gasoline.

### AUTO OUTPUT WILL AGGREGATE 5,200,000 THIS YEAR

New York. — According to Alfred Reeves, general manager of the National Automobile Chamber of Commerce, 5,200,000 motor cars and trucks will be produced in the United States during the present year. Of this quantity, 18 per cent. will be shipped abroad. This figure would set a new record for the automobile industry, as well as a new record for the country in manufactured exports. Throughout the year, an average of 20,000 cars a week are being shipped abroad, Mr. Reeves said.

---

J. S. Hess, chief engineer, Sinclair Refining Company, New York headquarters, has just completed a tour of all refineries of the company. Following completion of his tour at the company's Houston refinery, where his brother, G. L. Hess serves as engineer, he left for a vacation in California.

### ATLANTIC SEABOARD MORE ACTIVE IN 1928

Crude petroleum refined at plants on the Atlantic seaboard continued to increase during 1928 over preceding years, reaching a total of 170,506,000 barrels, as compared with 150,559,000 barrels in 1927 and 130,643,000 barrels in 1926, according to a statistical compilation made by E. B. Swanson for the United States Bureau of Mines. During each of the past two years the quantity of crude petroleum refined exceeded that of the preceding year by 20,000,000 barrels. Foreign crudes comprised 40 per cent. of the total 1928 throughput, as compared with 28 per cent. in 1927 and 22 per cent. in 1926. Foreign crude runs increased from 42,301,000 barrels in 1927 to 68,786,000 barrels in 1928, while domestic crude throughput registered a decrease of approximately 6,500,000 barrels. The quantity of domestic crude received at Atlantic Coast ports by tankers from Gulf Coast ports continued to increase, while receipts by tankers from California and by pipe line from the Mid-Continent field showed marked decreases. Crude capacities of Atlantic Coast refineries showed a slight increase, being rated at 588,200 barrels daily at the end of 1928, as compared with 581,700 at the beginning of the year.

The combination of increased foreign crude runs and decreased throughput of domestic crudes resulted in an increased production of gas and oil and fuel oil and a decrease in the relative production of gasoline. Gas oil and fuel oil production averaged 55.1 per cent. of the total crude run, as compared with 49.5 per cent in 1927 and 46 per cent. during 1926. Gasoline production showed an average of 31.5 per cent of the crude throughput, as compared with 32.7 per cent. in 1927 and 35.3 per cent in 1926. The output of straight-run gasoline was approximately equal to that of 1927, through an expansion of cracking operations. Total gasoline production showed an increase over the preceding year, although not equal in proportion to the increase in crude throughput. Cracking operations accounted for 40.6 per cent. of the gasoline produced, as compared with 35.3 per cent in 1927 and 38.2 per cent. in 1926. Gasoline demand in the Atlantic Coast area continued to increase, reaching a total of 106,567,000 barrels, as compared with 98,329,000 barrels in 1927 and 88,177,000 barrels in 1926. Receipts of gasoline by tankers from Gulf Coast and California ports increased over the preceding year.

#### Gulf Ports Shipping More

Domestic demand for gas oil and fuel oil in the Atlantic Coast area showed a small increase over 1927, mainly as a result of increased deliveries to steamships and a larger consumption of oil as fuel at refineries. The indicated demand for kerosene decreased from 10,156,000 barrels in 1927 to 9,166,000 barrels in 1928.

Receipts of crude oil by tankers from Gulf Coast ports reached a total of 92,745,000 barrels during 1928, showing progressive increases over similar receipts during preceding years: 85,212,000 barrels

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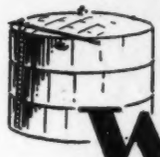

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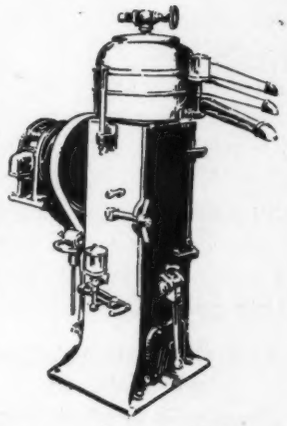

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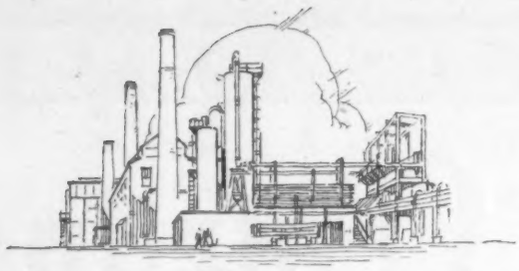

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in 1927; 78,992,000 barrels in 1926, and 72,556,000 barrels in 1925. Receipts of crude oil from California dropped from 10,651,000 barrels in 1927 to 3,330,000 during 1928. Pipe line deliveries of Mid-Continent crude also showed a marked decrease, dropping from 11,206,000 barrels in 1927 to 3,121,000 barrels in 1928. Pipe line deliveries from Illinois and Appalachian fields showed little change from the preceding year; 4,552,000 barrels were delivered in 1928, as compared with 4,667,000 barrels in 1927.

Increased runs of foreign crude at Atlantic Coast refineries necessarily brought about a similar increase in receipts of foreign crude. During 1928, 70,456,000 barrels of foreign crude were delivered at Atlantic Coast points, as compared with 42,989,000 barrels in 1927. Of the total crude oil received at Atlantic Coast refineries during 1928, 95.6 per cent. was received by tankers and 4.4 per cent. by pipe lines, as compared with 89.7 per cent. by tankers and 10.3 per cent. by pipe lines during 1927.

Production of gasoline at Atlantic Coast refineries reached a total of 53,694,000 barrels in 1928, an increase of 4,447,000 barrels, or 9 per cent., over the 1927 production of 49,247,000 barrels. Gasoline consumption in the Atlantic Coast area increased from 98,329,000 barrels in 1927 to 106,567,000 barrels in 1928. This increase of 8.38 per cent. in gasoline consumption did not quite equal the 9 per cent. increase in production, with the result that the output of Atlantic Coast refineries furnished 46.21 per cent. of the total Atlantic Coast demand, as compared with 45.41 per cent. in 1927.

The average recovery of gasoline per barrel of crude refined in 1928 was 31.5 per cent., or 13.2 gallons, as compared with 32.7 per cent., or 13.7 gallons, in 1927; and 35.3 per cent., or 14.8 gallons, in 1926. The output of gasoline by cracking was 40.6 per cent. of the gasoline production, as compared with 35.3 per cent. in 1927 and 38.2 per cent in 1926. The use of natural gasoline accounted for but 4.1 per cent. of the gasoline output, as compared with 5 per cent in 1927 and 8.2 per cent. in 1926. The output of gasoline by cracking totaled 21,788,000 barrels in 1928, as compared with 17,383,000 barrels in 1927. This increase of 4,405,000 barrels was virtually equal to the increase of 4,447,000 barrels shown for the total gasoline output, indicating that the output of straight-run gasoline at Atlantic Coast refineries during 1928 was about the same as in 1927.

Receipts of gasoline from other producing centers reached a total of 62,501,000 barrels, as compared with 56,580,000 barrels in 1927. Receipts by tanker from Gulf Coast ports increased by 4,315,000 barrels, while receipts from California increased by 4,696,000 barrels. In contrast with the decreases in refinery stocks during 1927 and 1926 of 2,610,000 barrels and 654,000 barrels, respectively, an addition of 762,200 barrels to refinery stocks was reported at the end of 1928.

Production of kerosene at Atlantic Coast refineries during 1928 totaled 8,563,000 barrels, a decrease of 1,853,000

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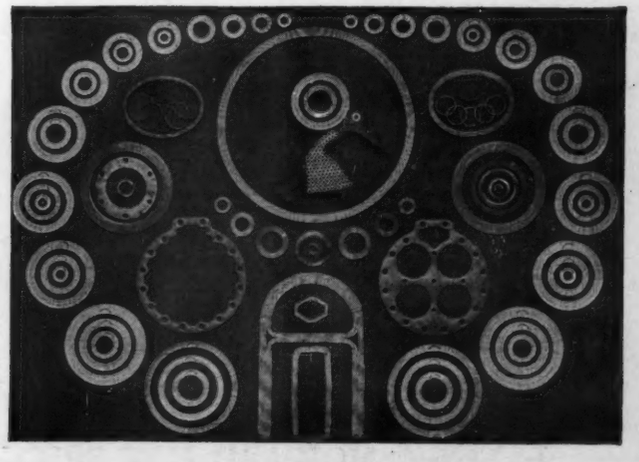

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barrels, or 17.8 per cent., from the 10,416,000 barrels reported for 1927. Tanker receipts from Gulf Coast ports were approximately the same as in 1927, being 5,861,000 barrels, as compared with 5,931,000 barrels during the preceding year. Exports from Atlantic Coast customs districts dropped from 6,735,000 barrels in 1927 to 5,481,000 barrels in 1928. The indicated domestic demand within the Atlantic Coast area, as computed, also showed a decrease, dropping from 10,156,000 barrels in 1927 to 9,166,000 barrels in 1928. Production at refineries within the area furnished 58.46 per cent. of the supply available during the year, while domestic demand accounted for 62.58 per cent. of the distribution, and shipments to foreign countries accounted for the remaining 37.42 per cent.

Production of gas oil and fuel oil at Atlantic Coast refineries during 1928 totaled 94,023,000 barrels, or a daily average of 256,900 barrels. This represents an increase of 19,565,000 barrels, or 26.3 per cent., over the 1927 production within the area. This increase in refinery production was compensated for primarily by the decrease in quantities received from other producing areas. These receipts dropped from a 1927 total of 48,558,000 barrels to 26,253,000 barrels in 1928. Furthermore, the quantities which had been added to refinery and terminal storage during 1927 were drawn upon during the early months of 1928, and continued withdrawals resulted in a decrease of 5,803,000 barrels in stocks held at the refineries. Production of gas oil and fuel oil at Atlantic Coast refineries during 1928 averaged 55.1 per cent. of the total crude run to stills, as compared with 49.5 per cent. in 1927 and 46 per cent. in 1926. The output of Atlantic Coast refineries was able to supply 75 per cent. of the 1928 regional demands, as compared with 60 per cent. during 1927.

Deliveries of gas oil and fuel oil, reported within the Atlantic Coast area during 1928, totaled 108,924,390 barrels, as compared with 107,875,732 during 1927 and 110,157,469 during 1926. Deliveries during 1928 represented an increase of 1,048,658 barrels, or 1 per cent., over the preceding year.

Decreases in gas oil and fuel oil deliveries were general throughout the New England district. Some portion of this decrease may be accounted for by conversion of plants from oil-burning to the use of coal. It is understood that this applies particularly to the pulp-wood industry, and it is also reported that some of the larger power plants in this area have been converted to the use of pulverized coal. The relatively mild winter exercised some effect on the consumption of oil fuel in commercial and domestic heating. It seems apparent that increases in the installation of domestic oil-burning equipment were able to offset the lower unit consumption, but decreases in individual deliveries for commercial heating, particularly in Massachusetts, would indicate that this would not apply to commercial heating.

Deliveries of bunker oil in New York

Harbor continued to show an increase. The relatively low price of fuel oil was reflected in the increased quantities of oil burned as fuel at refineries and other plants operated by oil companies. In the South Atlantic States the principal decrease was in deliveries to railroads, but deliveries in Florida reflected the decreased demand for industrial fuel oil in that state.

Further details are given in Information Circular 6187, "Sources and Distribution of Major Petroleum Products, Atlantic Coast States, 1928," which may be obtained from United States Bureau of Mines, Department of Commerce, Washington, D. C.

## REFINERIES IN FOREIGN COUNTRIES

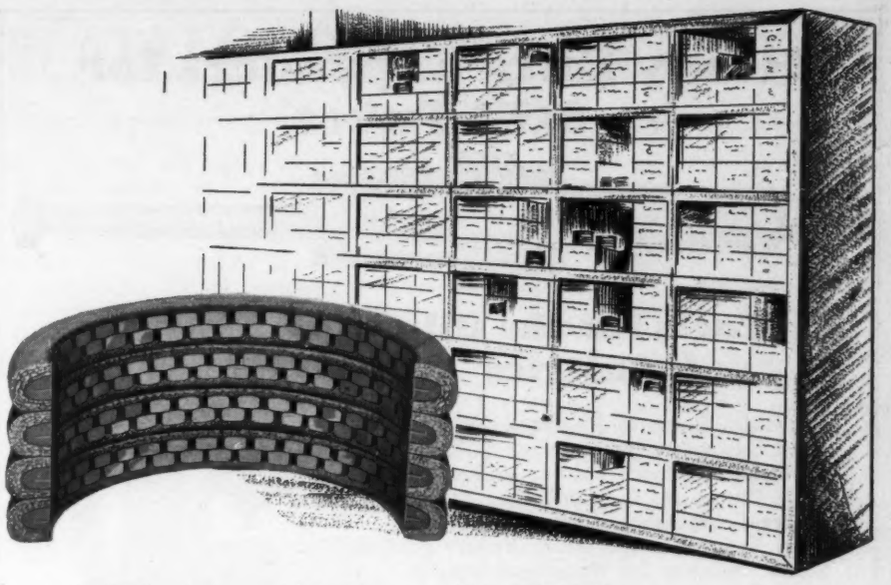
Washington. — Development of petroleum refining abroad is of intimate concern to the American industry, since exports of petroleum products rank second in value among all United States exports. The market for American refined products is affected in no small measure by the refining capacity of foreign countries. In order to present a comprehensive survey of the foreign refineries, the United States Bureau of Mines has published an interesting and valuable report which shows, by countries, all of the refineries outside of the United States. Besides giving a written and tabular review of the refining situation in foreign countries, this survey also includes a complete table of cracking plants in foreign countries. Those interested can obtain a copy of this survey by requesting Trade Information Bulletin No. 623, from the United States Bureau of Mines, Department of Commerce, Washington, D. C.

## EDUCATIONAL PICTURE DEPICTS PETROLEUM REFINING

The operations of the petroleum refining industry are picturized in a four-reel educational motion picture film entitled "Refining the Crude," which has just been prepared under the supervision of the United States Bureau of Mines, in cooperation with one of the large oil-refining companies.

Striking views of the great, closely-drilled Spindle Top oil field in Southern Texas remind one of the origin of the crude petroleum. The methods by which the crude oil is moved from well to refinery are visualized by the showing of long trains of tank cars and immense oil tankers, and by scenes showing the construction of pipe lines.

The highly intricate processes by which the crude petroleum is converted into the numerous products used by man are shown both by views of the actual refining processes and by the use of animated photography which makes plain the significance of the different stages of the processes employed. These scenes illustrate both the straight distillation process and the breaking down of the crude oil by "cracking" methods. Such phases of refinery operation as the travel of gases, the vaporization of oil, and the condensation of vapors are made plain by the use of animated drawings. The observer is shown just how the various

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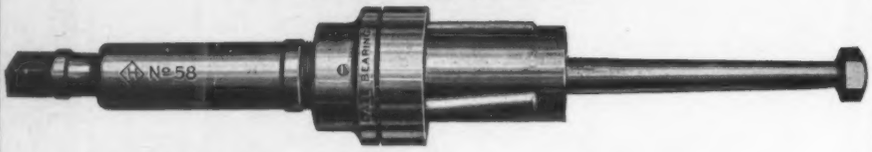


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an entirely new and improved type of graphite sealing paste for screw thread or flange joints, that is

**Not Soluble in Hot or Cold Oils**

*Expands* instead of shrinking when subjected to high temperatures and permanently remains in the expanded state assuring tight leakless joints for years of service.

**Dixon's Graphite Seal**

*Write for free test sample and circular 99-DS.*

JOSEPH DIXON CRUCIBLE CO.
Jersey City New Jersey
Established 1827

**DIXON'S GRAPHITE SEAL**


fractions of the oil, from which are made gasoline, kerosene, lubricants, gas oil and fuel oil are distilled. With the distillation of the crude petroleum carried to the point of dryness, an end product, known as petroleum coke, is obtained, and the handling of this fuel product, quite unfamiliar to the layman, is shown by actual photography taken inside a coke still.

A series of views illustrate how gasoline storage tanks are designed to reduce heavy evaporation losses. It is shown how some of the huge tanks are water sprayed, some water topped, and others equipped with floating roofs.

The making of paraffin wax from the lubricating fractions of paraffin-base crude oils is picturized. These views show the preparation of the wax by chilling, filtering, and pressing processes and also the removal of the wax from lubricating fractions by a battery of centrifuges running 17,000 revolutions per minute. The manufacture of lubricating greases by the mixing of soaps with lubricating oil is also picturized.

The use of gas masks by men working near poisonous fumes is shown, and as an object lesson in safety, a workman is seen overcome by gases, after which a first-aid crew comes to his rescue. Other scenes show the measures taken to fight the ever-present menace of fire.

Copies of this educational motion picture film "Refining the Crude" may be obtained for exhibition purposes by addressing the Pittsburgh Experiment Station of the United States Bureau of Mines, Pittsburgh, Pennsylvania. The film is available for showing by schools, clubs, churches, petroleum refiners, civic and business bodies, and other organizations or persons interested. No charge is made for the use of the film, although the exhibitor is asked to pay transportation charges.

### PETROLEUM REFINING CAPACITY EXPANDS

Washington.—On January 1, 1929, there were 413 completed petroleum refineries in the United States, with a total daily crude capacity of 3,509,540 barrels, according to the United States Bureau of Mines. In addition, 14 refineries with a potential capacity of 99,000 barrels were being constructed. Information Circular 6116, containing the bureau's statistical survey of the industry, shows that the majority of the refiners have followed a steady expansion program commensurate in most cases with the increase in demand for petroleum products. Obsolete equipment has been dismantled and modern equipment has been installed, with the net result that the total capacity of completed refineries has shown a steady increase since January 1, 1918. Of the total number of completed or building plants, 185 possessed cracking equipment, which, in combination with a few plants not connected with refineries, had a total charging capacity of 1,476,874 barrels daily. Copies of this report can be obtained from the United States Bureau of Mines, Department of Commerce, Washington, D. C., requesting Information Circular 6116.

# NEW EQUIPMENT, CATALOGS, BULLETINS, BOOKS

## LINE PIPE BULLETIN

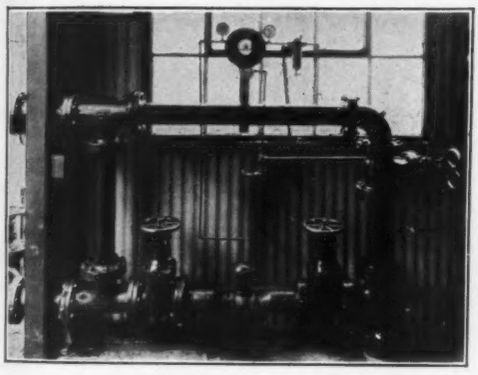
A bulletin just off the press is devoted to description of Naylor line pipe, a product of the Naylor Pipe Company, Chicago. This bulletin, No. 29-2, features the light weight of Naylor line pipe through photographic illustrations of two men carrying 40 feet of six-inch pipe on their shoulders on a Seminole, Oklahoma, field job. Another photograph shows three men carrying three 30-foot lengths of six-inch pipe, which is being layed for an oil trunk line at Kinta, Oklahoma. Another illustration of the light weight of this pipe is given in a photograph taken at Tulsa of a 1½-ton truck hauling nine 40-foot lengths of 16-inch line pipe. All illustrations used in this 26-page treatise of Naylor line pipe are photographs of scenes in the field. A copy of this bulletin is available by writing the main office and plant, 1230 East 92nd Street, Chicago.

## ELECTROCHEMICAL CATALOG

The Hooker Electrochemical Company, 25 Pine Street, New York City, is distributing an 80-page book covering its products in a neatly outline illustrated review. Topics discussed include a brief history of the chlorine and electrolytic caustic soda industry, caustic soda, chlorine, bleaching powder, muriatic acid, monochlorbenzene, paradichlorbenzene, benzoate of soda, benzoic acid, benzoyl chloride, benzyl alcohol or phenyl carbinol, antimony trichloride, ferric chloride, sulfur monochloride, sulfur dichloride, sulfuryl chloride, salt, chemical equivalents and properties, atomic weights, conversion factors, and temperature conversion tables.

Inquiries concerning a copy of the publication should be addressed to the address given above.


*Tycos Steam Boiler Gas Fuel Regulator*
*(Pilot Operated)*



*Tycos Steam Boiler Gas Fuel Governor (Pilot Operated), maintaining constant steam header pressures in natural gasoline power plant by regulating the gas supply to the battery of boilers.*

**This installation insures constant steam pressures under varying load conditions by properly regulating the gas fuel supply to the burners. Full steam pressures are maintained under extreme operating conditions, thus insuring a high efficiency and consistent operation of the boiler plant.**

**An increase in steam consumption or tendency toward a drop in boiler pressure immediately re-acts through the regulator to further open the diaphragm valve in the gas supply line, to such a position as is necessary to maintain constant steam pressures under this new condition; a decrease in steam consumption, or tendency toward an increase in boiler pressure likewise immediately re-acts to throttle down on the diaphragm valve to meet this more limited fuel requirement. More gas is admitted or the supply is throttled down as the load increases or decreases.**

**With the Tycos installation shown above the operator has complete information before him as to the pressures he is controlling, and the exact action of the control valve.**

*Write today for further information on this installation.*

*Taylor Instrument Companies*
Rochester, N. Y., U. S. A.
*Canadian Plant:* Tycos Bldg., Toronto
*Manufacturing Distributors in Great Britain:*
Short & Mason, Ltd., London

**Tycos Temperature Instruments**
INDICATING-RECORDING-CONTROLLING


## SAFETY CATALOG

The Mine Safety Appliances Company, Braddock, Thomas and Meade Streets, Pittsburgh, has just issued its now No. 4 General Catalog of 160 pages covering everything for mine and industrial safety. Copies will be furnished gratis to those interested in the safety and welfare of employees.

This new catalog contains a large number of illustrations, many of which are reproduced in colors. It is subdivided into the following general classifications of products: Edison electric safety cap lamps and accessories, permissible shot firing devices, Wolf flame safety lamps, gas and air measuring devices, rock dusting equipment, oxygen breathing apparatus, gas mask respiratory protective equipment, gas detectors and recorders, resuscitation equipment, eye and head protective equipment, safety clothing, safety saws and complete line of first aid supplies. Features include the "Lung," a practical submarine self-rescue device and an improved gas mask face piece developed in the M-S-A experimental laboratories.

## METERS, RECORDERS, SELSYN MOTOR

The Bailey Meter Company of Cleveland, is now distributing a general bulletin which briefly describes all products of its manufacture.

The products listed in this bulletin are automatic control, boiler meters, multi-pointer gages, tachometers, fluid meters, both the mechanically and electrically operated types; temperature and pressure recorders, steel meter boards, feed water regulators, pressure reducing valves, drainage controls, pump governors, copper tubing and compression fittings, selsyn operated devices, weir meters, gas meters, gravity recorders for liquids and coal meters. This four-page bulletin contains 15 illustrations as well as references to other bulletins which give complete information on the various products.

Selsyn operated devices for remote indication and record of liquid level, flow, pressure, temperature, draft, position and other factors, is the title of another Bulletin No. 110 issued recently

*Eight Points of Superiority in*

**C. H. WHEELER**

HEAT EXCHANGERS

1. High heat transfer rate.
2. Low pressure losses.
3. Compactness.
4. Accessibility for easy cleaning.
5. Removable tube bundle.
6. Floating tube plate.
7. Low maintenance costs.
8. Can be operated either vertically or horizontally.

*Made in all sizes for any Vacuum or Pressure*

**C. H. Wheeler Mfg. Co.**

19th St., Lehigh & Sedgley Aves.,
PHILADELPHIA, PA.

C. H. WHEELER *of* PHILADELPHIA

The Campbell Engineering Co.
1060 Broad St., Newark, N. J.

*Manufacturers of the TAR BABY BURNER handles Fuel Oils, Water Gas Tar, Acid Sludge, and Residue Fuels.*

Without obligating us in any way, please send information on ( ) the Watermelon Type of Steam Control for Oil Stills; ( ) the Pumpkin Seed Type, ( ) the Tar Baby Oil Burner for burning residue and other fuels.

Name.....
Firm.....
Address.....

by the Bailey Meter Company of Cleveland.

This catalog explains how the Selsyn motor, a device which is in use on the more modern battleships for directing and controlling gun fire, has been applied to the long distance transmission of various indications and records. Photographs, drawings and diagrams illustrate the principle of operation and the numerous applications in which this simple and reliable system of long distance transmission may be used.

The application of the Selsyn motor to control systems is also explained in this bulletin.

C. B. LYNDE

C. B. Lynde has recently been appointed district engineer for Struthers-Wells Titusville Corporation, with headquarters at 503 Exchange National Bank Building, Tulsa. He has had a wide range of experience on refinery and natural gasoline plant equipment. Formerly he was connected with the sales department of the United Iron Works in the Tulsa and Dallas offices.

### ABRASIVE PRODUCTS

The Carborundum Company, Niagara Falls, New York, has issued a 48-page catalog, which lists with descriptions and illustrations its numerous products for grinding, rubbing and polishing. The title of this catalog is "Abrasive Products," and is designated as Catalog No. 99. A copy is available upon application to the company.

### HIGH-PRESSURE PUMPS

Bulletin No. 99 of the Deming Company, Salem, Ohio, describes and illustrates the company's new line of patented self-oiling, high pressure pumps, which are built in a large variety of sizes. Photographs of the pumps in operation in the field are carried in the catalog. It is complete with tables showing specifications of a number of the featured pumps.

**Rubshell**

FOR

**Inside of Tanks**

WITHSTANDS

**$H_2S$ & $H_2SO_4$**

*and other corrosives met with in Refineries*

**THE ONLY PAINT TRIED, TESTED and USED EXTENSIVELY by the PRINCIPAL COMPANIES**

*Also for condensers, agitators, kettles, exchangers, etc.*

STOP THAT CORROSION TO-DAY!

**VOLCO**

HOLZAPFEL'S HEATPROOF PROTECTIVE

WITHSTANDS

**RED HEAT!**

*Use it on any surface too hot for other paints*

Extensively used for hot smoke stacks, exhaust pipes, mufflers, etc.

*NEW YORK*
INTERNATIONAL COMPOSITIONS CO., INC.
25 Broadway

*TULSA, OKLA.*
NATIONAL TANK SEAL CO.

*HOUSTON, TEXAS*
RUBSHELL, TEXAS, INC.
Post-Dispatch Bldg.

### SUPERHEATER CATALOGS

Steam superheaters for return tubular boilers and spray deck towers manufactured by The Marley Company, 1737 Walnut Street, Kansas City, Missouri, are interestingly described, with illustrations, in two catalogs, No. 23 and No. 24, which are available upon application.

### ENGINEERING FIRM EXPANDS

Announcement has recently been made by the Jackson Engineering Corporation of the opening of a district office at 714 Second National Bank Building, Houston, for the purpose of being in closer contact with customers in South Texas and Louisiana. E. F. Hudson is in charge of the new office. The company represents the Heat Transfer Products, Inc., and the Fluor Corporation, Ltd., and handles heat exchangers, fractionating towers, cooling towers, gasoline plant and compressor station equipment.

### OFFICE ADDRESS CHANGED

The Central Iron & Steel Company, Harrisburg, Pennsylvania, announces a change in the address of its Boston office, which is now in the Statler Building, Park Square. Former location was at 131 State Street. G. T. Armstrong is in charge of this branch.

### ABSORPTION PLANT BULLETIN

Southwestern Engineering Corporation, 606 South Hill Street, Los Angeles, is mailing out copies of its new bulletin dealing with Southwestern gasoline absorption plants. A number of changes have been made in regards to apparatus and operation, requiring larger capacity plants, and this development of equipment and service is covered in this bulletin.

A Southwestern absorption plant flow sheet is carried in the bulletin along with a discussion on plant operating instructions, and a table of characteristic operating data is published. The different types of plants with specifications are outlined in tabular form.

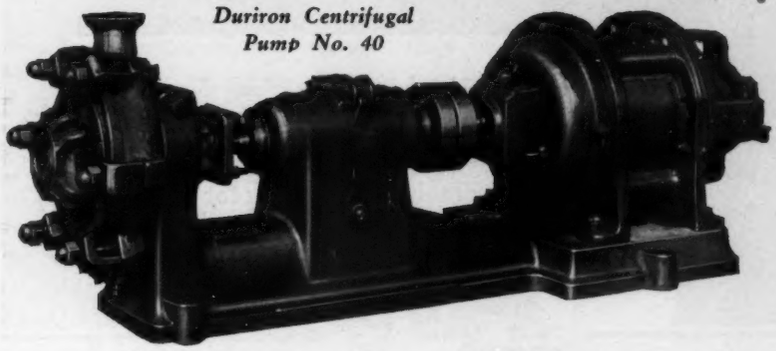
### INDICATOR PAMPHLET

Bacharach Industrial Instrument Company, 7000 Bennett Street, Homewood Station, Pittsburgh, has had literature printed which covers developments in the company's line of Maihak engine indicators. Copies of the pamphlets will be mailed to interested persons upon request.

The Maihak type with power integrator is covered in one pamphlet, the Maihak type for speeds up to 2200 revolutions per minute and pressures up to 5000 pounds is covered in another, and the Maihak type for Diesel, gas and steam engines, ammonia compressors and pumps is covered in a third pamphlet.


# Acid Handling

*Duriron Centrifugal Pump No. 40*



*New!*

*A Duriron Centrifugal Pump that is Self-Priming is now ready for delivery. Bulletin No. 155 gives complete details. Yours for the asking.*

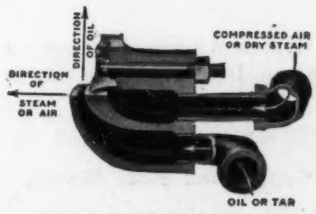
A DURIRON pump handles acid with less power, time and attention than compressed air, and eliminates danger of tank and line rupture by excessive pressure.

Maintenance expense is extremely low, as all parts in contact with the liquid handled are Duriron, and therefore extremely resistant to the dual attack of corrosion and erosion.

These pumps are produced in sizes to meet any requirements. Complete information on request.

THE DURIRON COMPANY, Inc.
Dayton, Ohio

**DURIRON**
**FOR ACID SERVICE**



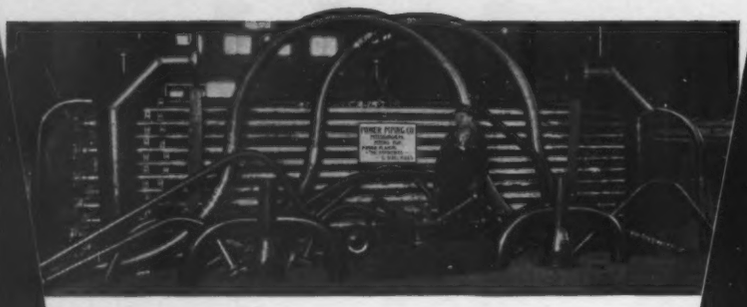

W. N. BEST High Pressure Oil Burner

**W. N. BEST Oil Burners**
*are*
**dependable, efficient, economical, non-clogging atomizers of fuel oils, tars, acid sludges and still bottoms.**

*Write for catalogs.*

**W. N. BEST CORPORATION**
*Engineers and Manufacturers Since 1890*
295 Fifth Avenue, New York City

PIPE BENDS



In the oil field pipe bends of various shapes and dimensions are an essential in the piping system—no matter how complex the job may be "put it up to POWER PIPING"—a specialized organization catering for years to the peculiar needs of this industry!

Power Piping

FOR EVERY OIL FIELD NEED

0-4

POWER PIPING COMPANY
PITTSBURGH

For cracking process in oil refineries we furnish Aluminum Armored Asbestos filled Gaskets and Corrugated Armco Iron or Monel Metal Asbestos encased.

Copper rings 3/16" thick for 4 and 5" O. D. tubing.

Washers or gaskets made of Aluminum, Copper and other Metals.

*Write for Prices.*

METALLO GASKET CO.

NEW BRUNSWICK, N. J.

## HIGH TEMPERATURE CEMENT

Harbison-Walker Refractories Company, Pittsburgh, has issued a neatly bound 12-page booklet, titled "Firebond," covering its high temperature cement. The booklet contains some new and useful tables for calculating the quantities of brick required for arches of different spans and thicknesses.

The manufacture and use of Firebond, a product for reducing furnace maintenance costs and prolonging the life of refractory linings in furnaces, is illustrated in this booklet. Twenty-four uses recommended by the company for this product are outlined and briefly explained in the booklet.

## ROTARY POSITIVE BLOWERS

The "RSB" and "RBB" series of Connersville rotary positive blowers, manufactured by the Connersville Blower Company, Connersville, Indiana, are described in Bulletin No. 123, which is now available. Detailed information on the use of these blowers in process industries for delivering air in medium pressures up to 10 and 12 pounds per square inch is given in the bulletin.

The bulletin also contains tables of capacity and pressure ratings of the different blowers built in this series.

## FILTER AIDS

The Johns-Manville Company, 292 Madison Avenue at Forty-first Street, New York, has recently had published a new brochure entitled "Celite Filter-Aids." Twenty pages are devoted to describing and explaining the use of the company's products, filter-cel and super-cel in the operation of correct filteration.

This brochure is available upon request at the above address.

## FEED WATER REGULATORS

Northern Equipment Company, Erie, Pennsylvania, has recently issued a new catalog, which carries a complete description of Copes feed water regulators for both low and high pressure service, with many interesting photographs of actual installations.

The Copes Type RG combined feed-flow-pressure regulator, is, for the first time, included in a Copes control valve, the Copes condensate drainage control and the Copes valve movement indicator. All of these products offer widespread applications in power plants of industrial and central stations.

## RESPIRATORY EQUIPMENT

The Mine Safety Appliances Company, Braddock, Thomas and Meade Streets, Pittsburgh, has issued Bulletin No. 26, containing pertinent questions and answers relative to respiratory protective equipment. This booklet, which will be furnished upon request, is illustrated with photographs and drawings which show the use of various respiratory equipment.

### OPEN HOUSTON STORE

The Standard Brass & Manufacturing Company, Port Arthur, Texas, of which H. J. La Blanc is president, has recently opened a branch warehouse in Houston at 1015 North San Jacinto Street. This store, which is in charge of J. H. Bannister, is stocked with products of the company's manufacture, including brass, bronze and copper rolling mill products and line cast aluminum, and is in a position to give the oil refiner and producer a more direct service in the Houston territory on Standard Brass & Manufacturing Company products.

---

The American LaFrance & Foamite Corporation, manufacturers of all types of fire extinguishing equipment, including motor fire apparatus, will move its Utica office and plant to the company's main office and plant at Elmira, New York. This change, which will be completed late this fall, has already been effected in the advertising, engineering and sales departments.

### NEW BRANCH STORE STOCKED

The Stockham Pipe & Fittings Company, Birmingham, Alabama, is now carrying an extensive line of fittings for both the producing and refining branches of the industry in its Houston branch store. H. S. Williams, formerly purchasing agent for Sinclair Oil & Gas Company's Gulf Coast headquarters, Houston, is manager of this branch, which is located at 2311 Polk Avenue.

### BAILEY METER OFFICE MOVED

Bailey Meter Company of Cleveland, Ohio, manufacturers of power plant metering equipment, automatic combustion control and feed water regulators, announces the transfer of its Boston office to 523 Public Service Building, 89 Broad Street. P. T. Reuter, who has represented the Bailey Meter Company in this territory for anumber of years, will continue as branch manager.

---

The Selden Company, Pittsburgh, manufacturer of chemicals, has recently published a 16-page booklet entitled "New Contact Sulphuric Acid Process," which will be mailed to interested persons upon request to the company. The new process is based on the inventions of Dr. A. O. Jaeger, technical director of the Selden Company. A second booklet, "A New Contact Sulphuric Acid Process," by Dr. Jaeger, is also available by writing to the Selden Company.

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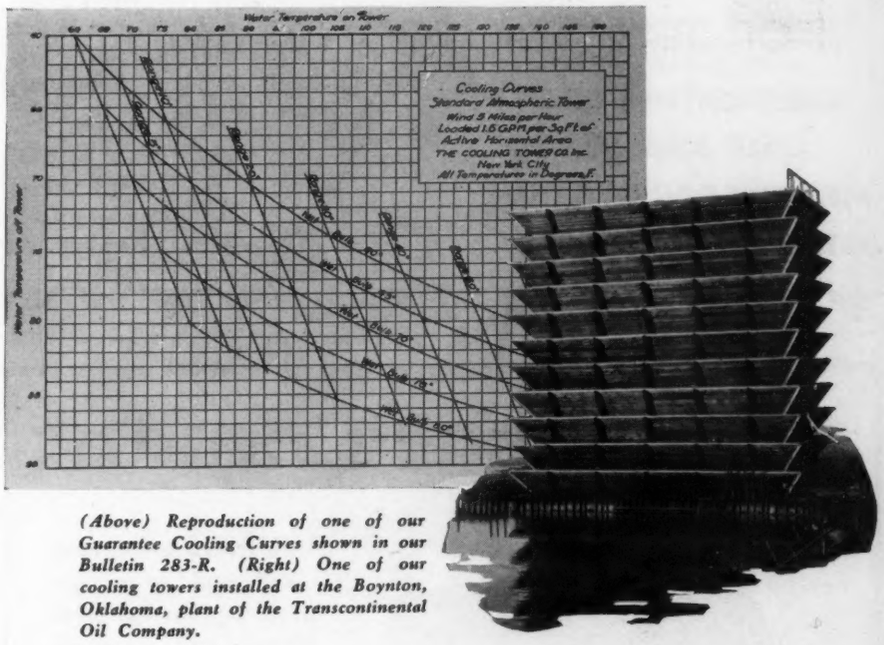
W. H. Arnold, formerly assistant sales manager of the Pittsburgh Valve, Foundry & Construction Company, has recently been appointed sales manager, succeeding C. A. Anderson, Jr., who became president of the company March 1. Arnold's association with the company dates back to 1905. He worked in the plant for 12 years, and in 1917 became engaged in selling.


# What Is This Knowledge Worth to You As a Buyer?

**TO KNOW definitely, in advance, what cooling results you are going to get under any given atmospheric conditions. To know that these results are guaranteed by a company with 20 years of experience in the cooling tower field. To know that the cooling tower you buy is a carefully designed piece of engineering equipment built especially for your plant.**

**All these factors, and many others, are worth considering. To base your decision on price alone may prove expensive. The cooling tower which costs you more in the beginning may cost the least in the long run. From your experience you know this to be true with other equipment.**

***Bulletin 283-R* should be in your files. A request will bring as many copies as you want by return mail.**


Water Temperature on Tower
Cooling Curves
Standard Atmospheric Tower
Wind 5 Miles per Hour
Loaded 1.5 G.P.M. per Sq.Ft. of
Active Horizontal Area
THE COOLING TOWER Co Inc.
New York City
All Temperatures in Degrees F.
Water Temperature off Tower

*(Above) Reproduction of one of our Guarantee Cooling Curves shown in our Bulletin 283-R. (Right) One of our cooling towers installed at the Boynton, Oklahoma, plant of the Transcontinental Oil Company.*

## THE COOLING TOWER COMPANY, INC.

15 JOHN STREET NEW YORK, N. Y.

*Distributors in Principal Cities*

WALTER J. PODBIELNIAK—PAUL M. RAIGOROLSLY

*Consulting Engineers*

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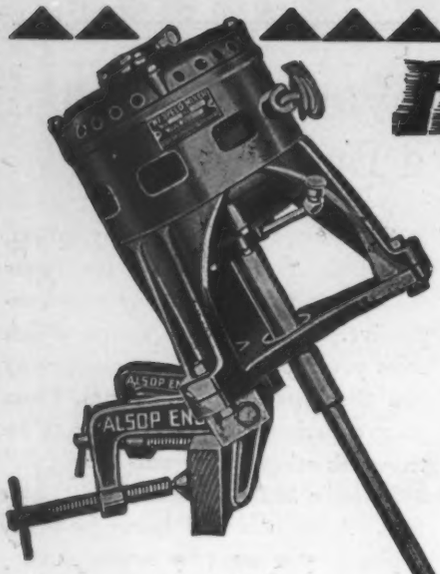
NATURAL GASOLINE PLANT DESIGN AND OPERATION

ANALYTICAL AND RESEARCH LABORATORIES

FRACTIONAL DISTILLATION ANALYSIS



Hy-Speed

EXPLOSION-PROOF MIXERS

Hy-Speed Portable Electric Mixers are the most efficient machines manufactured for blending, compounding, mixing or agitating all oils and liquid chemicals.

They clamp to any tank or vat in one minute and produce a more thorough, rapid mix . . . . more economically than by any other process. Capacities from five to 50,000 gallons.

Write for your copy of «The Hy-Speed Age» ..... the Solution of your Mixing Problems.

For mixing

LUBRICATING OILS
LIME AND OIL
FULLER'S EARTH & OIL
ALL LIQUID CHEMICALS

ALSOP ENGINEERING COMPANY
47 West 63rd St.
New York City



Acid-Proof Cement

Guaranteed to be acid, alkali and corrosion proof against all acids, alkalies and chemicals, —hydrofluoric acid alone expected. Our Acid-Proof Cement is widely used as a binder for Acid-Proof Brick and Tile.

*May we send you a free sample tube?*

The U. S. Stoneware Co.
44 Church Street, New York, N. Y.

U.S.STONEWARE


## REFRACTORY BULLETIN

Denver Fire Clay Company has recently published a 60-page catalog, 141-V, on fire brick, fire brick shapes, mouldable furnace lining and high temperature cements. It contains accurate notes and tables on furnace construction, and supersedes all previous refractory bulletins of this company.

Bulletin 142-V has also been published by the company, describing the company's flat suspended arches, monolithic furnace wall construction and suspended arches for horizontal return tubular boilers.

This literature will be mailed to engineers, superintendents and purchasing agents upon request to P. O. Box 1107, Denver.

---

General Refractories Company has recently announced the appointment of the Desch Supply and Equipment Company, 16 South Frederick Street, Baltimore, as its high temperature cement dealer representative in Maryland. The Desch Supply and Equipment Company's territory will include Washington, D. C., and will cover the state east of Allegany County and west and north of Chesapeak Bay.

## WELDING CATALOG

The Torchweld Equipment Company, 224 North Carpenter Street, Chicago, has just recently issued Catalog No. 29, entitled "Torchweld" and covering the company's line of welding and cutting equipment. It is a 40-page catalog, well illustrated, and covers in detail welding and cutting equipment, cutting units, torches, regulators and piece parts. A copy of this catalog is available upon request.

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The International Derrick & Equipment Company, Columbus, Ohio, just announced the purchase of acreage in Houston, with the intention of building a large manufacturing plant there. The company has just acquired five acres fronting approximately 1000 feet on the Beaumont highway and served by trackage of the Missouri Pacific, Southern Pacific and Houston Belt & Terminal Railway. Option is held on five additional acres for future expansion. Construction of the first unit of the International Derrick & Equipment Company of Texas plant will be started soon.

Harry M. Runkle, president of the International Derrick & Equipment Company, has personally conducted the negotiations for the Houston property, looking forward to the use of Houston's seaport to offer a convenient shipping point for export business to South America, Europe and South Africa.

The Houston plant will manufacture derricks and other oil well equipment, transmission towers and sub-stations for the electric light and power industry, radio towers, standard steel buildings, airplane hangars, airport buildings and towers, flood lights and signal bridges for railroads, besides structural steel fab-

rications and commercial galvanizing. The plant in Houston will be complete and modern in every way and will afford employment to hundreds of workmen.

Early last month the company purchased the Boykin Machinery & Supply Company of Beaumont. This firm has since been reorganized as a subsidiary of the International Derrick & Equipment Company proper into the International Derrick & Equipment Company of Texas, under which will come the management of both the Beaumont and the new Houston plants. Officers of the subsidiary Ideco company are Harry M. Runkle, Columbus, Ohio, president; B. Boykin, Jr., Beaumont, vice-president and general manager, and Lucien L. Powell of Houston, secretary and treasurer.

Other plants of the company are located at Columbus, Ohio, Delaware, Ohio, and Torrance, California. Division offices are maintained at New York, Detroit, Wichita, Tulsa, Fort Worth, Beaumont, Houston, Shreveport, Los Angeles and Maracaibo, Venezuela, with branches and warehouses in important oil fields.

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Winnett, Mont.—Property of the Weowna Refining Company at Winnett was sold for delinquent taxes a week ago. It sold for more than the appraised value.

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**STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912**

Of The Refiner and Natural Gasoline Manufacturer, published monthly at Houston, Texas, for October 1, 1929.

State of Texas, County of Harris:

Before me, a Notary Public in and for the State and county aforesaid, personally appeared A. L. Burns, who, having been duly sworn according to law, deposes and says that he is the General Manager of the Refiner and Natural Gasoline Manufacturer and that the following is, to the best of his knowledge and belief, a true statement of ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher: R. L. Dudley, 3238 Huntington Drive, Houston, Texas.

Editorial Director: S. W. Robinson, 4915 Louisiana St., Houston, Texas.

Editor: Grady Triplett, P. O. Box 562, Tulsa, Oklahoma.

Managing Editor: J. Kent Ridley, 4401 Greeley, Houston, Texas.

General Manager: A. L. Burns, 4311 San Jacinto, Houston, Texas.

2. That the owners are: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.)

The Gulf Publishing Company, Houston, Texas. James Anderson, Houston, Texas; R. L. Blaffer, Houston, Texas; Mrs. Sarah Campbell Blaffer, Houston, Texas; A. L. Burns, Houston, Texas; J. F. Carter, Jr., Tulsa, Oklahoma; Dr. N. L. Dudley, Goose Creek, Texas; R. L. Dudley, Houston, Texas; W. S. Farish, Houston, Texas; Wm. V. Gross, Houston, Texas; Howard R. Hughes, Houston, Texas; Chas. H. Lane, Houston, Texas; J. H. McEvoy, Houston, Texas; Wallace E. Pratt, Houston, Texas; J. Kent Ridley, Houston, Texas; S. W. Robinson, Houston, Texas; R. S. Sterling, Houston, Texas; O. R. Waller, Chicago, Illinois.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are:

Houston National Bank, Houston, Texas.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholders or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

A. L. BURNS,
General Manager.

Sworn to and subscribed before me this 25th day of September, 1929.

(Seal) J. KENT RIDLEY.

(My commission expires June 1, 1931.)


# Non-Sparking Tools!

**Eliminate the spark hazard in *your* plant! Equip your spray booths, cleaning rooms, and other working enclosures permeated with inflammable fumes . . . with PULMOSAN Ampco Non-Sparking tools.**

**PULMOSAN tools are a *new* development . . . practically as tough as steel (far superior to brass or copper); and will not squash or flake off. Made in all standard styles—or made to specification. Write for discriptive folder.**

# PULMOSAN
## SAFETY EQUIPMENT CORPORATION

*"If It's for Safety . . . We Have It."*

182 JOHNSON STREET BROOKLYN, N. Y.

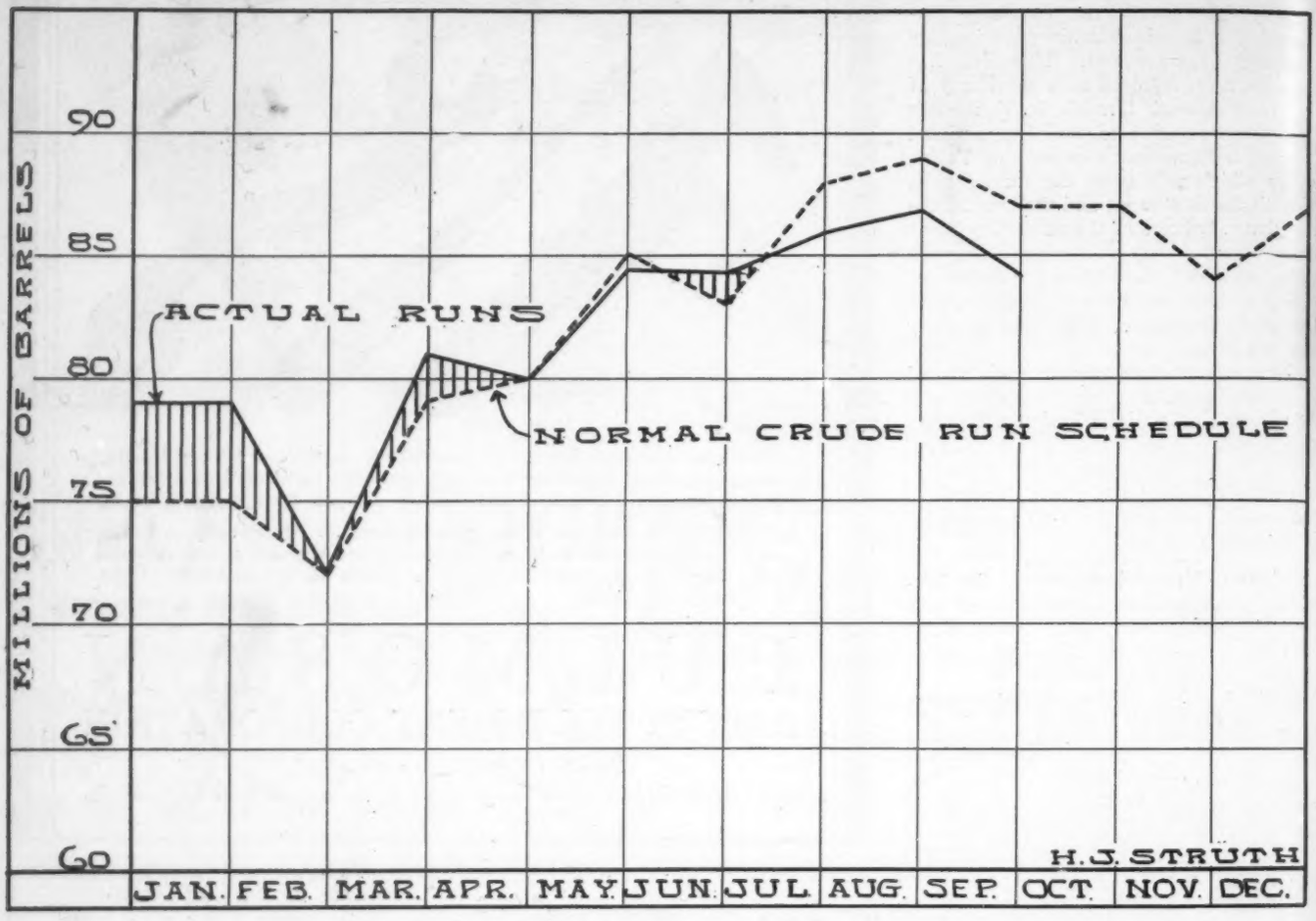
# The CF Duplex Sensitive Vacuum Regulator

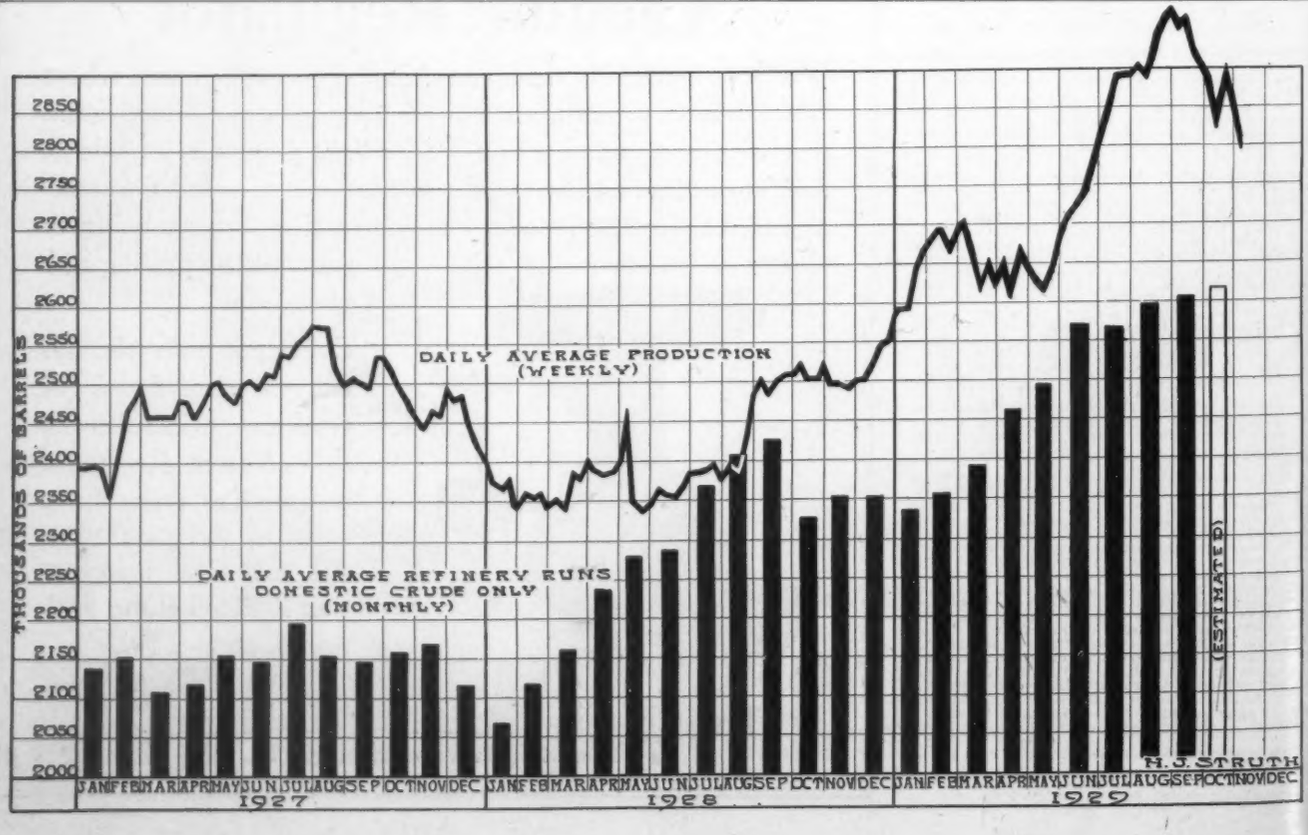
We have especially designed this Regulator to serve where it is desirable to maintain atmospheric pressure on a system discharging gases to a line, under light pressure. It acts as a safeguard when used in the vapor lines connected to storage tanks, for the recovery of gases, the purpose being to prevent the pulling of a vacuum.

Every gas man who has not yet considered the working principles of this efficient Regulator is urged to write for a copy of our catalogue. All technical information is listed along with prices, etc.

**The Chaplin-Fulton Manufacturing Co.**
28-40 Penn Ave., Pittsburgh, Pa.

## REFINERY RUNS OF DOMESTIC AND FOREIGN CRUDE TO STILLS




## DOMESTIC PRODUCTION AND REFINERY RUNS